



Project Manual

for

2022 Arnold MS Renovation

PBK Project No.: 220023

for the

CYPRESS-FAIRBANKS  
DISTRICT

INDEPENDENT

SCHOOL

17 February 2025

Issue for Proposal





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# 2022 Arnold MS Renovation

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for the

**CYPRESS-FAIRBANKS  
DISTRICT**

**INDEPENDENT**

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## Issue for Proposal

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Director of Project Management  
Director of Construction Field Services  
Senior Project Manager



# Project Manual

for

## 2022 Arnold MS Renovation

PBK Project No.: 220023

for the

### CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT

17 February 2025

## Issue for Proposal

### Team

#### **Architect**

PBK  
11 Greenway Plaza Blvd, 22<sup>nd</sup> Floor  
Houston, Texas 77046  
Phone: (713) 965-0608

#### **Structural**

Kubala Engineers  
11 Greenway Plaza Blvd, Ste. 1500  
Houston, Texas 77046  
Phone: (713) 940-3343

#### **MEPT**

LEAF Engineers  
11 Greenway Plaza Blvd, Ste. 1510  
Houston, Texas 77046  
Phone: (713) 940-3300

#### **Civil**

Brooks and Sparks  
21020 Park Row Drive  
Katy, Texas 77449  
Phone: (281) 578- 9595

#### **Door Hardware**

Assa Abloy  
9001 Jameel Road, Ste. 190  
Houston, Texas 77040  
Phone: (713) 934-9095

#### **Facilities**

BEAM Professionals  
11 Greenway Plaza Blvd, 22<sup>nd</sup> Floor  
Houston, Texas 77046  
Phone: (713) 940-3201

#### **Landscape**

Edgeland Group  
11 Greenway Plaza, 15<sup>th</sup> Floor  
Houston, Texas 77046  
Phone: (713) 460-0988

#### **Environmental**

EFI Global Inc.  
8811 FM 1960 Bypass Rd. W Ste 400  
Humble, Texas 77338  
Phone: (281) 466-0251

#### **Theatrical**

WJHW  
3424 Midcourt Road, Ste 124  
Carrollton, Texas 75006  
Phone: (972) 934-3700

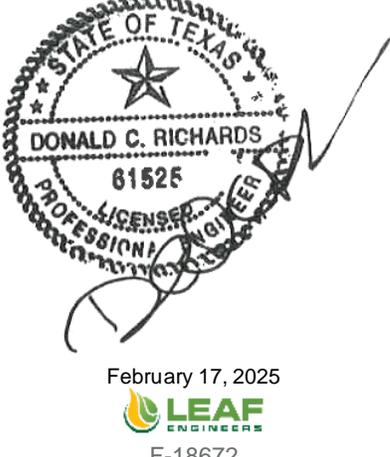
#### **Acoustic**

BAI  
4006 Speedway  
Austin, Texas 78751  
Phone: (512) 476-7851

Issue for Proposal

Each specification section included herein is listed in the Project Manual Table of Contents with a letter code, indicated below, designating the Designer of Record responsible for its preparation, under whose seal and/or authority it is issued for the purpose(s) stated above. Seals and signatures do not apply to documents not included herein, nor (except as otherwise indicated) to documents prepared by the Owner or others ("O"), including but not necessarily limited to documents in Division 00, geotechnical and other reports, etc.

<p><b>Architect of Record:</b>                   Brandon D. Ross                   R.A. # 27540</p>	 <p>02/17/2025</p>	<p>PBK                  11 Greenway Plaza Blvd, 22nd Floor                  Houston, Texas 77046                  Phone: (713) 965-0608</p>
<p><b>Architect of Record, Landscape:</b>                   Jacob Galles                   L.A. #3002</p>	 <p>02/17/2025</p>	<p>Edgeland Group                  11 Greenway Plaza Blvd, 15<sup>th</sup> Floor                  Houston, Texas 77046                  Phone: (713) 460-0988</p>
<p><b>Engineer of Record, Structural:</b>                   John R. Kubala                   P.E. # 106120</p>	 <p>2/17/2025  <b>Kubala</b> Engineers                  F-23612</p>	<p>Kubala Engineers                  11 Greenway Plaza Blvd, Ste. 1510                  Houston, Texas 77046                  Phone: (800) 248-3674</p>

<p><b>Engineer of Record, Mechanical:</b></p> <p>Mital Patel, P.E.</p> <p>P.E. #111622</p>		<p>LEAF Engineers 11 Greenway Plaza Blvd, Ste. 1510 Houston, Texas 77046 Phone: (713) 940-3300</p>
<p><b>Engineer of Record, Electrical:</b></p> <p>Matt Sickorez, P.E.</p> <p>P.E. #107736</p>		<p>LEAF Engineers 11 Greenway Plaza Blvd, Ste. 1510 Houston, Texas 77046 Phone: (713) 940-3300</p>
<p><b>Engineer of Record, Plumbing &amp; Technology:</b></p> <p>Don Richards, P.E.</p> <p>P.E. #61525</p>		<p>LEAF Engineers 11 Greenway Plaza Blvd, Ste. 1510 Houston, Texas 77046 Phone: (713) 940-3300</p>

<p><b>Engineer of Record, Civil:</b>  Frank E. Brooks  P.E. # 49225</p>	 <p>The seal is circular with a five-pointed star in the center. The outer ring contains the text "STATE OF TEXAS" at the top and "REGISTERED PROFESSIONAL ENGINEER" at the bottom. Inside the ring, the text reads "FRANK E. BROOKS" and "49225". A handwritten signature is written across the seal, and the date "02-17-25" is printed at the bottom.</p>	<p>Brooks and Sparks 21020 Park Row Drive Katy, Texas 77449 Phone: (281) 578-9595</p>
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**DOCUMENT AA**

**REQUEST FOR COMPETITIVE SEALED PROPOSALS**

Competitive Sealed Proposals for the work described below in accordance with Proposal Documents and addenda as may be issued prior to date of proposal opening will be received by the Board of Trustees, Cypress-Fairbanks Independent School District, until proposal closing date and time, as identified below. Proposals from Offerors will then be opened in public and read aloud.

**OWNER:** Cypress-Fairbanks Independent School District  
11440 Matzke Rd.  
Cypress, Texas 77429  
Representative: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction

**ARCHITECT:** PBK Architects  
11 Greenway Plaza, 22nd Floor  
Houston, TX 77046  
713-965-0608

**PROJECT:** **2022 Arnold MS Renovation**  
CFISD Proposal Number: 21-10-5708R-RFP

**LOCATION:** **11111 Telge Rd.,**  
**Cypress, TX 77429**

**PROPOSED CONSTRUCTION BUDGET:** **\$ 17,554,977.79**

**PRE-PROPOSAL CONFERENCE:** **Wednesday, February 19, 2025 at 9:00 AM** at Cypress-Fairbanks Independent School District, Facilities & Construction Conference Room, 11430-B Perry Road, Houston, Texas 77064. Representatives of the Architect and Owner will be present at this meeting. All offerors are encouraged to attend.

**PROPOSAL DATE AND TIME:** **Thursday, March 6, 2025** Base Proposal: 2:00 PM  
Alternate Proposal: 3:00 PM

**LOCATION OF PROPOSAL OPENING:** Cypress-Fairbanks Independent School District  
Facilities and Construction  
11430-B Perry Road  
Houston, Texas 77064  
(281) 897-4108

Proposal Documents will be available on/after **Monday, February 17, 2025**. General Contractor Offerors may obtain five (5) sets of drawings and specifications at the place identified below upon deposit of **\$100.00** per set with check made payable to **PBK Architect**. The deposit will be returned when the Plans and Specifications are returned in good condition. Additionally, General Contractor Offerors must submit of a fully executed AIA Document A305, Contractor's Qualification Statement to the office of the Architect at the time proposal documents are obtained.

In addition, proposal documents can be reviewed at the following locations:

ISqFt Plan Room (AGC)  
8450 Westpark, Ste. 100  
Houston, Texas 77063  
Ph: (713) 843-3700 Fx: (713) 843-3701

McGraw-Hill Construction/ Dodge Data & Analytics  
www.dodgeplans.construction.com or contact Toni.Lawson@construction.com Ph: (281) 460-5730

Office of PBK **Architect**

**FULL REFUND:** Deposits will be returned provided all Contract Documents and addenda are returned to the Architect complete with all sheets bound in their original order within ten (10) days of the opening of proposals.

**FORFEIT OF DEPOSIT:** When the Documents are not returned under the conditions specified, none of the deposit will be returned. However, the Documents shall remain the property of the Owner and must be returned.

All proposals must be in the hands of the Owner no later than the time specified above. Please seal all proposals in duplicate in an envelope with the following information on the face of the envelope.

Name of Offeror (General Contractor)  
**2022 Arnold MS Renovation**  
Cypress Fairbanks Independent School District  
Cypress-Fairbanks I.S.D. Proposal Number: 21-10-5708R-RFP  
\_\_\_\_\_(Name of Bonding Company)  
Attn: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction

The Owner reserves the right to reject any and all proposals and to waive any informality in the Competitive Sealed Proposal process. No proposal shall be withdrawn within sixty (60) days after the proposal opening without the specific consent of the Owner. Refer to Offerors Section Document AB.

**SELECTION CRITERIA:** Selection criteria are included in Document AB of the Project Manual and Selection Criteria and are available on request by perspective Offerors from the office of the Architect.

**PROPOSAL BOND:** A Proposal Bond from a bonding company acceptable to the Owner or a certified check in an amount equal to 10% of the greatest amount proposed must accompany each offeror's proposal.

**PAYMENT BOND AND PERFORMANCE BOND:** A Payment Bond and Performance Bond, each in an amount equal to 100% of the Contract Sum conditioned upon the faithful performance of the Contract will be required. Refer to Section AB, Instructions to Offerors for detailed Bond requirements.

The prevailing rates of wages as stipulated in the Supplementary Conditions here within are the minimums that must be paid in conformance with all applicable laws of the State of Texas.

All Offerors (General Contractors) submitting proposals are encouraged to attend the proposal opening and visit the Project site.

Subcontractors and Suppliers intending to submit proposals to General Construction Offerors are required to prepare their proposals based on a complete set of proposal documents. If after reviewing the complete set of proposal documents, Subcontractors and Supplier Offerors desire to purchase individual drawings and specification sections for their proposal convenience, they may do so by ordering the specific drawings and specifications directly from the reproduction company. Each offeror purchasing a partial set of proposal documents is responsible for determining exactly which documents he requires and is responsible for all costs associated with printing and delivery. Subcontractors and Suppliers exercising this option must agree to do so on the basis that 1) all documents shall be returned to the Architect, without refund, after submitting a proposal and 2) documents shall not be used on other construction projects. Successful Subcontractors and Supplier Offerors may retain their Proposal Documents until completion of the construction. The subcontractor/supplier is responsible for all the associated work and coordination when not obtaining a complete set of drawings.

**END OF DOCUMENT**



## DOCUMENT AB

### INSTRUCTIONS TO OFFERORS

#### 1. QUALIFIED OFFERORS

- A. Proposals will be accepted from qualified General Contractors only for the entire scope of work described in the Contract Documents. As a prerequisite to a Contractor's qualifying for the award of contract on this work, the Contractor must complete each item of the Contractor Information and Experience Statement (AIA Document A305<sup>TM</sup>). The Statement forms may be obtained from the office of the Houston Chapter of the American Institute of Architects (A.I.A), 315 Capitol, Suite 120; Houston, TX 77002. The Statement and 3 references of similar projects with current/verified phone numbers, email address and current/verified fax numbers for references of Owner and Architect (refer to Exhibit A on page 9), shall be submitted to the Architect by **5:00P.M. CST on Monday, February 24, 2025**.
- B. Every interested Offeror shall be required to submit AIA Document A305<sup>TM</sup> (Contractor's Information and Experience Statement) to Architect. AIA Documents submitted by fax transmission will not be accepted.
- C. The primary purposes of the evaluation process will be to:
  - 1. Gather information for the Owner's evaluation procedure.
  - 2. Enable the Architect to evaluate the Contractor's qualifications and determine which Contractors the Architect could recommend to the Owner should such recommendation be requested by the Owner.
- D. After completion of the Contractor evaluation process, the Architect will notify the Owner and each Contractor who has submitted a Contractor's Qualification Statement as to the Architect's opinion. In the event the Owner chooses to determine the acceptability of Contractors prior to receipt of Proposals, the Contractors will be notified of the Owner's decision prior to the proposal date, otherwise the Owner will make his decision after receipt of proposals.
- E. In arriving at his opinion concerning the Contractor's qualifications, the Architect will use the same criteria that the Owner will use in determination of the successful Contractor as detailed hereinafter.
- F. In the event an Offeror fails to submit the specified Contractor's Qualification Statement in accordance with the schedule established, such noncompliance shall be considered by both the Owner and Architect as a negative factor in the determination of the successful Offeror.
- G. In the event the Architect notifies a Contractor that it is the Architect's opinion the Contractor has not sufficiently demonstrated his qualifications to perform the subject Contract, taking into consideration the items listed under Paragraph 19.A and the Contractor subsequently decides to submit a Proposal, the Contractor shall be doing so with the knowledge that the Architect will not recommend him as a qualified Offeror.

#### 2. OFFEROR'S PRESENTATION

Each Offeror by making their Proposal represents that:

- A. The Offeror has read and understands the Proposal Documents and their Proposal is made in accordance therewith.
- B. The Offeror has visited the site, has familiarized themselves with the local conditions under which the work is to be performed and has correlated their observations with the requirements of the proposed Contract Documents.

- C. The Offeror agrees to comply with the requirements of the following paragraph. These requirements are absolute, and any Offeror who subsequently does not agree to comply with these requirements will automatically disqualify himself from proposing or receiving award of the contract.
  
- D. The Offeror agrees that:
  - 1. Work on the project will begin immediately upon the General Contractor's receipt of CFISD's Notice to Proceed. The NTP will be accompanied by CFISD's purchase order.
  - 2. On-site mobilization will not begin until after the Bonds and Certificate of Insurance have been reviewed and approved by the Owner and that timely submittal of correct Bonds and Certificate of Insurance is solely the responsibility of Offeror.
  - 3. Offeror will participate as a team member in cooperation with the Owner and Architect.
  - 4. The Offeror will assign competent full-time superintendents and that these superintendents shall be maintained on the project for the duration of the project including completion of all punch list items, subject only to their continuous employment.
  - 5. The Offeror will furnish and pay for a proposal bond in the amount of ten percent (10%) of the greatest amount proposed.
  - 6. If awarded, the Offeror shall furnish and pay for a Performance Bond and a Payment Bond each in the full contract amount.
  - 7. Offeror and its subcontractors shall comply with requirements listed in Document BD, Insurance and Bonds Requirements for Contractors and Facility Renters.
  - 8. Each Offeror by making their Proposal represents that their Proposal includes only material and equipment specified in the Proposal Documents and supplemented, if necessary, for a complete and operating system.
  - 9. Each Offeror by making their Proposal represents that their Proposal includes the employment of Subcontractors that meet or exceed the Installer Qualifications described in the Project Manual.
  - 10. Each Offeror (and sub-Offeror or supplier submitting a proposal to an Offeror) shall submit an affidavit stating that no asbestos, PCBs or lead building materials will be incorporated into the Work.

### **3. PROPOSAL DOCUMENTS**

- A. Proposal Documents include the Proposal Forms, Contract Forms, Specifications, Drawings, Addenda and documentation as noted in AIA Document A201<sup>TM</sup>-2017, as amended.

### **4. INTERPRETATION OF PROPOSAL DOCUMENTS**

- A. Offerors and sub-Offerors requiring clarification or interpretation of the Proposal Documents shall make a written request using the form bound in the Project Manual, which shall reach the Architect at least ten (10) days prior to the date for receipt of proposals.
- B. Any interpretation, correction or change of the Proposal Documents will be made by Addendum. Interpretations, corrections or changes of the Proposal Documents made in any other manner will not be binding.

### **5. SUBSTITUTIONS OF MATERIALS AND EQUIPMENT**

- A. The materials, products and equipment described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an addendum as a substitution prior to the submission of proposals.

- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least ten (10) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. No substitutions will be considered after the Contract award.

## **6. ASBESTOS, LEAD AND PCB CONTAINING MATERIALS, PRODUCTS AND SYSTEMS**

- A. The use of asbestos or PCB's in any construction process is strictly prohibited
- B. Prior to submitting a proposal, Offerors shall notify the Architect, in writing, of any materials, products and systems in these specifications which are known to contain or are likely to contain asbestos, lead or PCBs. The Architect will promptly explore possibilities for selecting other materials, products and systems which would circumvent the problem and notify Offerors of any changes in an addendum, otherwise it will be understood that only specified materials, products and systems that are asbestos, lead, and PCB free are included in the proposals.
- C. Prior to payment of Retainage and Final Payment, the Contractor and all subcontractors shall furnish a notarized statement certifying that no asbestos/PCB's, or asbestos/PCB-containing materials have been used in this Project.

## **7. INSURANCE**

- A. Each Offeror shall include in his proposal the complete cost for insurance required under the Amended General Conditions, Supplementary Conditions and Specification Document BD, Insurance and Bond Requirements for Contractors and Facility Renters. Coverage shall remain in full force for the duration of the Project.

## **8. PERFORMANCE BOND AND PAYMENT BOND**

- A. Each Offeror shall include in his base proposal, the premium costs for 100% Performance Bond and 100% Payment Bond. Bonds shall be written by a Surety Company included in the latest State Board of Insurance, Bond Department's "List of Insurance Companies Licensed to Write Fidelity and Surety Bonds in Texas, and the latest United States Department of the Treasury's Listing of Approved Sureties (Department Circular 570). The Owner reserves the right to make inquiries about the current financial stability of the Surety, including demands for proof of sound reinsurance, proof that claims are being met, and current financial information. The Owner reserves the right to reject Bonds written by a Surety that, in the Owner's judgment, does not provide proof of sound reinsurance and or does not provide proof that claims are being met.

## **9. PROPOSAL PROCEDURES**

- A. A proposal is invalid if it has not been received at the designated location prior to the time and date for receipt of proposals indicated in the Request for Competitive Sealed Proposals, or prior to any extension thereof issued to the Offerors by Addenda.
- B. All requested Alternates shall be proposed. If no change in the Base Proposal is required, enter "No Change".

- C. Prior to the receipt of Proposals, Addenda will be transmitted to each person or firm recorded by the Architect as having received the proposal documents in accordance with the Request for Competitive Sealed Proposals, and will be available for inspection wherever the proposal documents are available for that purpose.
- D. Proposals must be submitted in duplicate and only on the Proposal Forms included in the Project Manual, in sealed envelopes addressed as follows:

Name of Offeror (General Contractor)  
*Competitive Sealed proposal for:*  
2022 Arnold MS Renovation  
Cypress-Fairbanks Independent School District  
Cypress-Fairbanks ISD Proposal Number: 21-10-5708R-RFP  
\_\_\_\_\_  
*Name of Bonding Company*  
Attn: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction  
Facilities, Planning & Construction  
11430-B Perry Road  
Houston, Texas 77064

- E. All proposals must be delivered sealed to the above address stipulated in the Request for Competitive Sealed Proposals at or before the time and date set. Proposals will be received at no other place. If Proposal is sent by U.S. Mail, it must be sent Registered Mail.
- F. The Owner reserves the right to reject any Proposal if the evidence submitted by, or investigation of, such Offeror fails to satisfy the Owner that such Offeror is properly qualified to carry out the obligations of the contract and to complete the work therein. Conditional proposals will not be accepted. Award may be made to other than the low-dollar Offeror and given to the one offering the “best value” to the school district, in addition to the purchase price, based on the published selection criteria and on its ranking evaluation.
- G. A proposal may be withdrawn only upon request by the Offeror or his duly authorized representative, provided such written request is received by the Owner at the place designated for receipt of proposals and prior at least forty-eight (48) hours before the time fixed for the opening of proposals. The Proposal Bond will be returned with the proposals if withdrawn in accordance with the above. The withdrawal of a proposal does not prejudice the right of the Offeror to file a new proposal at the time and place stated. No proposal may be withdrawn after the time fixed for the opening of proposals for a period of sixty (60) days.

**10. SUBMISSION OF ADDITIONAL PROPOSAL INFORMATION**

- A. The Offeror shall submit with his Alternate Proposals:
  - 01 Proposal Form AC Alternates
  - 02 An experience profile (resume) of the proposed superintendent(s) and project manager(s). These experience profiles will be considered by the Selection Committee in the evaluation of the Offeror’s proposal.
  - 03 The firm names of the major subcontractors and/or suppliers requested on the Alternate Proposal Form AF.
  - 04 Signed and Notarized Special Owner Requirements Sections 01 35 23 and 01 35 23.1.
  - 05 An experience profile (resume) of the Offeror, including a list of projects completed of similar size and scope. These experience profiles will be considered by the Selection Committee in the evaluation of the Offeror’s proposal.

**11. FELONY CONVICTION NOTIFICATION**

- A. Each Offeror shall execute and submit Form AE, Statement of Affirmation within the sealed envelope containing the Base Proposal.

- B. Section 44.034, of the Texas Education Code requires a person or business entity that enters into a contract with a school district must give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony. Subsection (b) states “a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract.” Subsection (c) states “this section does not apply to a publicly held corporation”.

## 12. PROPOSAL EVALUATION WAIVER

- A. Each Offeror shall execute and submit Form AG, Proposal Evaluation Waiver within the sealed envelope containing the Base Proposal.
- B. All Offerors shall agree to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The Offeror further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

## 13. AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

- A. Each Offeror shall execute and submit Form AH, Affidavit of Non-Discriminatory Employment within the sealed envelope containing the Base Proposal.
- B. All Offerors, Contractor and subcontractors shall agree to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and Rules and Regulations issued in order to maintain and insure non-discriminatory employment practices.

## 14. CONFLICT OF INTEREST QUESTIONNAIRE

- A. Each Offeror shall execute an on-line Conflict of Interest Questionnaire and submit Form AN within the sealed envelope containing the Base Proposal.

## 15. PROPOSAL SECURITY

- A. No proposal will be considered unless it is accompanied by a Certified or Cashier's Check or Proposal Bond executed on the form attached. In either case the amount shall be **not less than ten percent (10%) of the greatest amount proposed (considering alternates, if any)**. The proposal security shall insure the execution of the contract and the furnishing of acceptable Performance Bond, Payment Bond and Certificates of Insurance by the successful Offeror within ten (10) days after notification of award to such Offeror and that this proposal will not be withdrawn within sixty (60) days after date of opening of proposals without the consent of the Owner. Proposal Bond shall be submitted on AIA Document A310<sup>TM</sup>-2010 or on Form AD included in the Project Manual.
- B. Proposal Security shall be submitted within the sealed envelope containing Alternate Proposals.
- C. Withdrawal of a proposal by an Offeror, or refusal to enter into negotiations and/or acceptance of a contract for construction by an Offeror after the opening of proposals and within and including the sixtieth day after proposals shall subject the Offeror to the forfeiture of his proposal security to the Owner.

## 16. SUBMISSION OF POST PROPOSAL INFORMATION

- A. Each Offeror shall submit, by **5:00P.M. on Friday, March 14, 2025**, following documentation to the office of the Architect. The post proposal information submitted by the Offeror will be considered by the Selection Committee in the evaluation of the Offeror's proposal:
1. A bar-chart construction schedule delineating construction phasing including major construction milestone dates.
  2. A statement describing the Offeror's proposed management concept for the Project.
  3. A statement of all Work to be self-performed by the Offeror.
  4. Complete and fully executed Contractor Qualification Statement Form, AIA Document A305, for each of the subcontractors named on the Offeror's Alternate Proposal Form. Qualification statements must include a listing of past projects performed by the subcontractor that are of similar size and scope to the Project. Past project information must include the names and telephone numbers of the respective Owner's and Architect's representatives for those projects.
  5. Any voluntary Value Engineering items that the proposer would believe to be of interest to the Owner. (This VE list will not be considered part of the evaluation process and is entirely voluntary.)
  6. As part of post proposal negotiations the Owner may desire to discuss a voluntary option that would establish the amount to be added to the owner's contingency allowance as an incentive amount offered by the general contractor and identified sub-contractors for early payments made by the owner to the general contractor on or before the 15th day of each month following the specified billing period. In addition, General Contractor agrees to maintain timely payments to subcontractors upon payment to the general contractor by the owner. This incentive is made to the owner as a lump sum for each trade contract participating, the proposed amount offered is for the duration of the contract and shall be allocated on a percentage complete of total contract value per month per contractor or subcontractor offering the incentive for early payment. The amount of the incentive each month shall be the proposed value by trade for the incentive multiplied by the percentage completed that month of that trade or generals total contract, if the owner makes payment to the general contractor on or before the 15th day of the month following the billing period then the incentive would be recognized as a credit to the owners contingency allowance, if the payment is not made on or before the 15th by the owner then the incentive credit to the Owner that month would not be applied.  
  
A value for this incentive for the general contractor and the proposed list of subcontractors and values proposed for each that want to participate in this option will be submitted by the highest ranked proposer during post proposal negotiations.
- B. The selected Offeror shall execute Form AL, Certification of Project Compliance, and submit at Project Closeout.
- C. The selected Offeror shall execute and submit Form AP, Certification of Criminal History Record Information within 10 days after receipt of Notice to Proceed and prior to commencement of Work.

## 17. REJECTION OF PROPOSALS

- A. The Owner shall have the right to reject any or all proposals and to reject a proposal not accompanied by any required proposal security, or by other data required by the Proposal Documents, or to reject a proposal which is in any way incomplete, irregular, or not submitted by the published date and time as specified.

## 18. EVALUATION OF PROPOSALS

- A. The Owner may discuss proposals with Offerors after the proposal opening, to allow for clarification.

- B. The Owner shall endeavor to prevent non-monetary information from competing proposals being disclosed to other Offerors.
- C. The Owner will, within forty-five (45) days after the proposal opening, evaluate and rank each proposal submitted relative to the selection criteria.
- D. The Owner’s Selection Committee will select the Offeror that offers the best value based on the selection criteria and the Selection Committee’s ranking of the proposals.
- E. The Owner and Architect may discuss options with the selected Offeror for cost reduction and/or other Contract terms. If the Owner is unable to come to terms with the first ranked Offeror, discussions are to terminate and the Owner will proceed to the next ranked Offeror and repeat the process until a contract agreement is reached or all proposals are rejected.

**19. DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT**

A. In determining the Selected Offeror, the Owner will evaluate the information derived from the Offeror's (Contractor's) Qualification Statement, information received from completed Offeror's reference surveys, direct experience with the Offeror by Selection Committee members, the Offeror's proposal including information requested with the proposals and post proposal information submitted by the Offeror relative to the following Selection Criteria. A maximum of **one hundred twenty (120) points** may be scored to each proposal.

1.	Purchase Price – The purchase price will be scored mathematically as a weighted percentile score utilizing the proposal submitted and the weighted value of the criterion	40
2.	Reputation – Offeror and the Offeror’s goods and services for projects of similar size and scope	10
3.	Quality – Offeror and the Offeror’s goods and services for projects of similar size and scope	10
4.	Completion – Offerors past record of completing projects of similar size and scope on time and within budget	10
5.	Warranty – Offeror’s response to warranty work requests, the quality of the warranty work, and the Offeror’s record of monitoring and reporting back to the Owner on the progress of warranty work	10
6.	Close Out – Offeror’s record of closing out projects expeditiously	10
7.	Project Team – The qualifications of the Offeror’s proposed project manager(s) and project superintendent(s)	10
8.	Subcontractors – The qualifications of the Offeror’s proposed subcontractors	20
	Total:	120

The Selection Committee consisting of Cypress-Fairbanks ISD administrators, architects, consultants and other staff will make an initial evaluation of the proposals. Its recommendation will be considered by the Cypress-Fairbanks ISD Board of Trustees (“Board”). The District reserves the right to review the recommendation with the Asst. Supt. of Facilities & Construction, the Director of Construction Field Services, the Director of Design and Facilities Planning, and the Director of Project Management and others deemed appropriate by the District prior to review by the entire Board. The final decision-making authority on the proposals rests with the full Board. Decision-making authority has not been delegated to any person or entity other than the Board.

**20. AWARD OF CONTRACT**

- A. The Owner's Selection Committee's recommendation based on an evaluation and ranking of each proposal submitted in relation to the selection criteria will be presented to the Board of Trustees for approval and award of the contract for construction. Presentation of the Selection Committee's recommendation is anticipated to occur during the Board of Trustees' meeting on **April 14, 2025**.
- B. The Owner or the Architect, on behalf of the Owner, will issue a written Notice to Proceed after award of the contract for construction by the Board of Trustees.
- C. The selected Offeror shall submit to the Owner, for review and acceptance, a Performance Bond, a Payment Bond and Certificates of Insurance within ten (10) calendar days after receipt of a written Notice to Proceed.
- D. All Offerors shall hold pricing of all alternates open for consideration and acceptance by the District/Owner as noted on Alternates proposal form.

**21. ON SITE MOBILIZATION**

- A. The selected Offeror shall not commence on-site work under this Contract until he receives a written confirmation from the Owner approving the Performance Bond, Payment Bond and Certificates of Insurance. Timely submittal of correct Bonds and Certificate of Insurance is solely the responsibility of Offeror. Additional review time by the Owner due to Contractor's failure to do so will not constitute grounds for delay claims.

**22. CONTRACT TIME AND LIQUIDATED DAMAGES**

- A. Refer to the AIA Document A201<sup>TM</sup>-2017, as Amended for Contract Time and Liquidated Damages provisions of the Contract.

**23. AVAILABILITY OF MATERIALS AND SYSTEMS**

- A. A serious effort has been made to select only materials that are asbestos free and systems that are readily available. As far as is known at proposal time all items are either available "off the shelf" or within a relatively short period of time. If during the proposal period, an Offeror becomes aware of an availability or delivery problem with any of the specified systems or materials or if they contain asbestos, he should notify the Architect immediately. The Architect will promptly explore possibilities for selecting other systems or materials which would circumvent the problem and notify Offerors of any changes in an addendum, otherwise it will be understood that only specified systems and materials that are asbestos free are included in the proposals.
- B. Decisions regarding allowance items will endeavor to be made in a timely manner to avoid construction delays.



**EXHIBIT A**  
**REFERENCE LISTING FOR Cy-Fair ISD**  
**2022 Arnold MS Renovation**

OFFEROR NAME: \_\_\_\_\_

<b>PROJECT No. 1</b>	
Project Name: _____	Completion Date: _____
Contract Amount: \$ _____	Square Footage: _____
<b>OWNER</b>	<b>ARCHITECT</b>
Contact Name: _____	Contact Name: _____
Phone Number: _____	Phone Number: _____
or Email: _____	or Email: _____

<b>PROJECT No. 2</b>	
Project Name: _____	Completion Date: _____
Contract Amount: \$ _____	Square Footage: _____
<b>OWNER</b>	<b>ARCHITECT</b>
Contact Name: _____	Contact Name: _____
Phone Number: _____	Phone Number: _____
or Email: _____	or Email: _____

<b>PROJECT No. 3</b>	
Project Name: _____	Completion Date: _____
Contract Amount: \$ _____	Square Footage: _____
<b>OWNER</b>	<b>ARCHITECT</b>
Contact Name: _____	Contact Name: _____
Phone Number: _____	Phone Number: _____
or Email: _____	Or Email: _____

**END OF SECTION**

**FORM AC**  
**COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL**

**2022 Arnold MS Renovation**  
**Cypress-Fairbanks Independent School District**  
**Cypress-Fairbanks I.S.D. Proposal Number: 21-10-5708R-RFP**

Attn: Mr. Jesse Clayburn, Asst. Superintendent of Facilities & Construction

Submitted by: \_\_\_\_\_

Date: \_\_\_\_\_ Phone No.: \_\_\_\_\_

To: Board of Trustees  
Cypress-Fairbanks Independent School District  
Facilities and Construction  
11430-B Perry Road  
Houston, Texas 77064

Having examined Proposal and Contract Documents prepared by **PBK Architect** dated **Monday, February 17, 2025**, and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1. Hold Base Proposal open for acceptance sixty (60) days.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. By signing, the undersigned affirms that, to the best of his knowledge, the Proposals have been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.

**I. BASE PROPOSAL**

A. Undersigned agrees to complete the Work for the lump sum amount of:

\_\_\_\_\_ Dollars \$ \_\_\_\_\_  
(Amount written in words governs) (Amount in figures)

**II. ALLOWANCES**

Undersigned certifies that the allowances specified in Section 01 21 00 are included in the Base Proposal and agrees that unexpended balance of allowance sums will revert to Owner in the final settlement of the contract.

**III. CONTRACT TIME**

By submittal of this proposal, the undersigned stipulates that the Base Proposal includes all costs necessary to attain Substantial Completion of the Work on or before the date stipulated in AIA Document A101™-2017.

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 2:00 PM, March 6, 2025**  
**COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL**

**IV. ADDENDA**

Undersigned acknowledges receipt of Addenda Nos. \_\_\_\_\_ dated  
\_\_\_\_\_, \_\_\_\_\_.

**V. CHANGES IN THE WORK**

Undersigned understands that changes in the work shall be performed in accordance with the Supplementary Conditions.

**VI. LIQUIDATED DAMAGES**

By submittal of this proposal, the undersigned stipulates an agreement that if Substantial Completion of the Work is not attained on or before the date stipulated in AIA Document A101™-2017, the undersigned and his Surety shall be liable for and shall pay the Owner the sums stipulated as Liquidated Damages as defined in AIA Document A201™-2017.

It is understood that the right is reserved by the Owner to reject any or all proposals, or waive any informalities in the proposal process.

(Seal, if a Corporation)  
State whether Corporation,  
Partnership or Individual

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Name of Contracting Firm

\_\_\_\_\_  
Address

\_\_\_\_\_  
Telephone

\_\_\_\_\_  
Date

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 2:00 PM, March 6, 2025**  
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

**FORM AC**  
**COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSALS**

**2022 Arnold MS Renovation**  
**Cypress-Fairbanks Independent School District**  
**Cypress-Fairbanks I.S.D. Proposal Number: 21-10-5708R-RFP**  
Attn: Mr. Jesse Clayburn, Asst. Superintendent of Facilities & Construction

Submitted by: \_\_\_\_\_

Date: \_\_\_\_\_ Phone No.: \_\_\_\_\_

To: Board of Trustees  
Cypress-Fairbanks Independent School District  
Facilities and Construction  
11430-B Perry Road  
Houston, Texas 77064

Having examined Proposal and Contract Documents prepared by **PBK Architect**, dated **Monday, February 17, 2025**, and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1. Hold Alternate Proposal open for acceptance one hundred twenty (120) days.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. By signing, the undersigned affirms that, to the best of his knowledge, the Proposals have been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.

**I. ALTERNATES**

If the Owner accepts any or all of the Alternates, the undersigned agrees to modify the Base Proposal as stipulated below:

A. Alternate Number 1 – **Base Bid Adjustment**

ADD/DEDUCT _____	Dollars \$ _____
(Amount written in words governs)	(Amount in figures)

B. Alternate Number 2– **Building Controls by Wattstopper**

ADD/DEDUCT _____	Dollars \$ _____
(Amount written in words governs)	(Amount in figures)

**II. UNIT PRICES**

If the Owner accepts any or all of the Alternates, the undersigned agrees to add or subtract the following units of work:

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**  
**COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL**

**UNIT PRICE 1: REMOVAL OF UNSATISFACTORY SOIL AND REPLACEMENT WITH SATISFACTORY SOIL MATERIAL PER CUBIC YARD**

Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, according to Section 312000 "Earth Moving." Provide unit price for one cubic yard of soil excavated, based on survey of volume removed. Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances." Cost shall include all materials, labor, overhead and profit for complete installation satisfactory soil material. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 2: ROCK EXCAVATION AND REPLACEMENT WITH SATISFACTORY SOIL MATERIAL PER CUBIC YARD**

Classified rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, according to Section 312000 "Earth Moving." Provide unit price for one cubic yard of rock excavated, based on survey of volume removed. Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances." Cost shall include all materials, labor, overhead and profit for complete installation of satisfactory soil material. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 3: CUTTING AND PATCHING OF CONCRETE FLOOR SLABS PER SQUARE FOOT**

Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents. Provide a unit price for one square feet of concrete removed and replaced. Cost shall include all materials, labor, overhead and profit for complete installation of concrete floor slab. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 4: CEMENT STABILIZED SAND AND LEAN CONCRETE PER CUBIC YARD**

This unit price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for the complete installation of cement stabilized sand and lean concrete. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 5: SELECT FILL PER CUBIC YARD**

This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation of select fill. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 6: FLOWABLE FILL (CLSM) PER CUBIC YARD**

This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of flowable fill or controlled low-strength material (CLSM), delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 7: CONCRETE**

This unit price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new concrete material, delivery, labor for installation/ placement, formwork, etc per plans and specs. Reinforcement for concrete shall also be included and shall be assumed to be 2% minimum by volume. \$ \_\_\_\_\_/ea

**UNIT PRICE NO. 8: GRADE BEAM (ADD)**

This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302.1. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam.

1. GB1 \$ \_\_\_\_\_/ Foot
2. GB2 \$ \_\_\_\_\_/ Foot

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**  
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3.	GB3	\$ _____ /	Foot
4.	GB4	\$ _____ /	Foot
5.	GB5	\$ _____ /	Foot
6.	GB6	\$ _____ /	Foot
7.	GB7	\$ _____ /	Foot
8.	GB8	\$ _____ /	Foot
9.	GB10	\$ _____ /	Foot
10.	GB16	\$ _____ /	Foot

**UNIT PRICE NO. 9: GRADE BEAM (DEDUCT)**

This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam.

1.	GB1	\$ _____ /	Foot
2.	GB2	\$ _____ /	Foot
3.	GB3	\$ _____ /	Foot
4.	GB4	\$ _____ /	Foot
5.	GB5	\$ _____ /	Foot
6.	GB6	\$ _____ /	Foot
7.	GB7	\$ _____ /	Foot
8.	GB8	\$ _____ /	Foot
9.	GB10	\$ _____ /	Foot
10.	GB16	\$ _____ /	Foot

**UNIT PRICE NO. 10: DRILLED PIER (ADD)**

This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) drilled pier of each drilled pier size utilized in the project per 1/S-303. Cost shall include all materials, labor, detailing, overhead and profit for complete installation.

1.	24/48	\$ _____ /	Added pier
2.	30/60	\$ _____ /	Added pier
3.	36/72	\$ _____ /	Added pier
4.	39/78	\$ _____ /	Added pier
5.	45/90	\$ _____ /	Added pier

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**  
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**UNIT PRICE NO. 11: DRILLED PIER (DEDUCT)**

This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) drilled pier of each drilled pier size utilized in the project per 1/S-303. Cost shall include all materials, labor, detailing, overhead and profit for complete installation.

1.	24/48	\$ _____ /	Removed pier
2.	30/60	\$ _____ /	Removed pier
3.	36/72	\$ _____ /	Removed pier
4.	39/78	\$ _____ /	Removed pier
5.	45/90	\$ _____ /	Removed pier

**UNIT PRICE NO. 12: PIER CASINGS:**

The contractor shall provide a unit price for net length of casing utilized for all pier types utilized on the project. Cost shall include all materials, labor, overhead and profit for complete installation.

1.	24/48	\$ _____ /	Casing
2.	30/60	\$ _____ /	Casing
3.	36/72	\$ _____ /	Casing
4.	39/78	\$ _____ /	Casing
5.	45/90	\$ _____ /	Casing

**UNIT PRICE NO. 13: EXISTING PIER DEMO CONDITION 1 (OVERLAP WITH NEW PIER):**

At any location where a new pier will overlap an existing footing/pier, the soil currently in the existing footing/pier shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size.

1.	24/48	\$ _____ /	Pier Demo Condition 1
2.	30/60	\$ _____ /	Pier Demo Condition 1
3.	36/72	\$ _____ /	Pier Demo Condition 1
4.	39/78	\$ _____ /	Pier Demo Condition 1
5.	45/90	\$ _____ /	Pier Demo Condition 1

**UNIT PRICE NO. 14: EXISTING PIER DEMO CONDITION 2 (NO CONFLICT WITH NEW PIERS):**

At any location where an existing footing/pier does not overlap with a new pier, the portion of the existing footing/pier within 4.5 ft of the bottom of the future slab shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698). The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size.

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1.	24/48	\$ _____ /	Pier Demo Condition 2
2.	30/60	\$ _____ /	Pier Demo Condition 2
3.	36/72	\$ _____ /	Pier Demo Condition 2
4.	39/78	\$ _____ /	Pier Demo Condition 2
5.	45/90	\$ _____ /	Pier Demo Condition 2

**UNIT PRICE NO. 15: MISCELLANEOUS AND STRUCTURAL STEEL PER POUND**

Miscellaneous steel, structural steel, and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications." This unit price shall be the entire unit cost including overhead and profit for one (1) pound of fabricated steel as indicated on the itemized invoice of steel supplier and verified by the Architect. Cost shall include all materials, labor, detailing, engineering, erection, overhead and profit for complete installation. Enter unit cost on the Proposal Form.

\$ \_\_\_\_\_ /ea

**Unit Price No. 16: Gypsum Board**

This unit price shall establish the cost for installing a 9'-0" by 5'0" section of drywall, with a 3 5/8 stud, floated and painted.

\$ \_\_\_\_\_ /ea

**Unit Price No. 17: Tile Backer Board**

This unit price shall establish the cost for installing a 9'-0" by 5'0" section of tile backer board, with 3 5/8" stud, and prepped for tile.

\$ \_\_\_\_\_ /ea

**III. CONTRACTOR'S PROJECT TEAM MEMBERS**

The undersigned proposes the following project team members (include resumes):

Project Manager \_\_\_\_\_

Superintendent \_\_\_\_\_

Asst. Superintendent(s) \_\_\_\_\_

Project Engineer \_\_\_\_\_

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**

**COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL**



**III. PROPOSED SUBCONTRACTORS**

The undersigned proposes the following subcontractors. Note – Not all trades listed below will apply to every project.

Paving: \_\_\_\_\_

Abatement: \_\_\_\_\_

Dampproofing/insulator: \_\_\_\_\_

Masonry: \_\_\_\_\_

Roofing: \_\_\_\_\_

Drywall: \_\_\_\_\_

Casework: \_\_\_\_\_

Concrete: \_\_\_\_\_

Plumbing: \_\_\_\_\_

Mechanical: \_\_\_\_\_

Electrical: \_\_\_\_\_

Fire Alarm: \_\_\_\_\_

Sprinkler: \_\_\_\_\_

Low Voltage/Security: \_\_\_\_\_

Site Utilities: \_\_\_\_\_

Earthwork/Site Prep: \_\_\_\_\_

Fencing: \_\_\_\_\_

Glazing: \_\_\_\_\_

Laboratory Casework: \_\_\_\_\_

Masonry: \_\_\_\_\_

Steel: \_\_\_\_\_

Erector: \_\_\_\_\_

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**  
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

Demolition: \_\_\_\_\_

Sports Field: \_\_\_\_\_

Food Service: \_\_\_\_\_

Theatrical: \_\_\_\_\_

Theatrical AV: \_\_\_\_\_

Casework: \_\_\_\_\_

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**  
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

It is understood that the right is reserved by the Owner to reject any or all proposals, or waive any informalities in proposal process.

(Seal, if a Corporation)  
State whether Corporation,  
Partnership or Individual

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Name of Contracting Firm

\_\_\_\_\_  
Address

\_\_\_\_\_  
Telephone

\_\_\_\_\_  
Date

**END OF FORM**

**THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, March 6, 2025**  
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

**Arnold Middle School School  
Unit Prices for Asbestos Containing Building Materials (ACBM) – February 2025**

The following prices must be filled in by the proposer. The Asbestos Abatement Contractor proposes the following sums as additions to or deductions from the Base Price amount for changes to the scope of work.

**Identified ACBM at Arnold Middle School**

<b>No.</b>	<b>Unit Price Description</b>	<b>Add (\$/Figures)</b>	<b>Deduct (\$/Figures)</b>	<b>Unit of Measure</b>
ASB-1	Price per square foot for the proper removal, transportation, and disposal of interior <b>ACBM black damp proofing mastic behind brick veneer</b> . All work to be completed in compliance with AHERA and TAHPR regulations. – Full Containment	_____	_____	Square Foot
ASB-2	Price per square foot for the proper removal, transportation, and disposal of exterior <b>ACBM black damp proofing mastic behind brick veneer</b> . All work to be completed in compliance with NESHAP regulations.	_____	_____	Square Foot
ASB-3	Price per square foot for the proper removal, transportation, and disposal of <b>ACBM texture/plaster and/or overspray</b> . All work to be completed in compliance with AHERA and TAHPR regulations. – Full Containment	_____	_____	Square Foot
ASB-4	Price per square foot for the proper cleaning, wet wiping and HEPA vacuuming above ceiling surfaces (ceiling panels/surfaces, ductwork, piping, wiring, etc.), transportation, and disposal of <b>ACBM texture/plaster dust/debris</b> . All work to be completed in compliance with AHERA and TAHPR regulations. – Minimum prep per TAHPR	_____	_____	Square Foot
ASB-5	Price per square foot for the proper removal, transportation, and disposal of <b>ACBM vinyl floor tile and/or black mastic</b> . All work to be completed in compliance with AHERA and TAHPR regulations. – Full Containment	_____	_____	Square Foot
ASB-6	Price per linear foot for the proper removal, transportation, and disposal of <b>ACBM pipe insulation with mastic</b> via glovebag removal method including all necessary regulated work area <u>preparation and PPE</u>	_____	_____	Linear Foot
ASB-7	Price per linear foot for the proper removal, transportation, and disposal of <b>ACBM pipe insulation with mastic</b> . All work to be completed in compliance with AHERA and TAHPR regulations. – Full Containment	_____	_____	Linear Foot
ASB-8	Price per unit for the proper removal, transportation, and disposal of <b>ACBM sinks</b> . All work to be completed in compliance with AHERA and TAHPR regulations. (Component Removal)	_____	_____	Unit

ASB-9	Price per unit for the proper removal, transportation, and disposal of <b>ACBM fire doors and/or door transoms</b> . All work to be completed in compliance with AHERA and TAHPR regulations. (Component Removal)	_____	_____	Unit
ASB-10	Price per linear foot for the proper removal, transportation, and disposal of <b>ACBM underground pipe</b> . via glovebag removal method including all necessary regulated work area <u>preparation and PPE</u>	_____	_____	Linear Foot
ASB-11	Price per linear foot for the proper removal, transportation, and disposal of exterior <b>ACBM underground pipe</b> . All work to be completed in compliance with NESHAP regulations. <u>Without</u> excavation.	_____	_____	Linear Foot
ASB-12	Price per linear foot for the proper removal, transportation, and disposal of exterior <b>ACBM underground pipe</b> . All work to be completed in compliance with NESHAP regulations. <u>With</u> excavation.	_____	_____	Linear Foot

**FORM AD**

**PROPOSAL BOND**

**KNOW ALL MEN BY THESE PRESENTS**, that we \_\_\_\_\_,  
as Principal, and \_\_\_\_\_, as Surety, are held and firmly  
bound unto the Cypress-Fairbanks Independent School District, Harris County, Texas, hereinafter called the Owner, in  
the penal sum of \_\_\_\_\_ Dollars  
(\$ \_\_\_\_\_) lawful money of the United States, for the payment of which sum well and truly to be made, we  
bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents.

**THE CONDITION OF THIS OBLIGATION IS SUCH**, that whereas the Principal has submitted the accompanying  
Proposal, dated \_\_\_\_\_, \_\_\_\_\_, being for the \_\_\_\_\_, Cypress-Fairbanks  
I.S.D. Proposal Number: **21-10-5708R-RFP** for the Cypress-Fairbanks Independent School District, the kind and extent  
of work involved being set forth in detail in the proposed Contract Documents cited herein.

**NOW, THEREFORE**, if the Principal shall not withdraw the accompanying proposal within 60 days after the date set  
for opening thereof, and shall within ten (10) days after the prescribed forms are presented to him for signature, enter into  
a written contract with the Owner in accordance with the Proposal as accepted; and give Bond and good and sufficient  
surety for the faithful performance and proper fulfillment of such contract including payment of all persons supplying  
labor or materials therefor, or in the event of the withdrawal of said proposal within the period specified, or the failure to  
enter into such contract and give such bond within the time specified, if the Principal shall pay to the Owner the difference  
between the aggregate amount for which the Owner may enter into a contract for the same work with another Respondent;  
if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to  
remain in full force and virtue.

**IN WITNESS WHEREOF**, the above bonded parties have executed this instrument under their several seals this \_\_\_\_\_  
day of \_\_\_\_\_, \_\_\_\_\_, the name and Corporate Seal of each corporate party being  
hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing  
body.

\_\_\_\_\_  
Business Address

\_\_\_\_\_  
Individual Principal: Signature and Printed Name

\_\_\_\_\_  
Business Address

\_\_\_\_\_  
Individual Principal: Signature and Printed Name

ATTEST:

\_\_\_\_\_  
Secretary President

BY: \_\_\_\_\_

\_\_\_\_\_  
Business Address

\_\_\_\_\_  
Corporate Surety

ATTEST: \_\_\_\_\_

BY: \_\_\_\_\_

**END OF FORM**

***NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH ALTERNATE PROPOSAL.***

**FORM AE**

**FELONY CONVICTION NOTIFICATION**

**Note: The Statement of Affirmation Must Be Notarized**

**STATEMENT OF AFFIRMATION**

“The undersigned affirms that he/she is duly authorized to provide this information by the person(s) or business entity making the proposal, and the information provided below concerning felony convictions has been personally and thoroughly reviewed, and verified, and is, therefore, current, true and accurate to the best of my knowledge.”

Firm’s Name: \_\_\_\_\_ Address: \_\_\_\_\_

- “a. \_\_\_ My firm is a publicly held corporation, therefore, this reporting requirement is not applicable.”
- “b. \_\_\_ My firm is not owned nor operated by anyone who has been convicted of a felony.”
- “c. \_\_\_ My firm is owned or operated by the following individual(s) who has/have been convicted of a felony:”

Name of Felon(s) \_\_\_\_\_

Details of Conviction(s) \_\_\_\_\_  
\_\_\_\_\_

PLEASE CHECK a, b, or c ABOVE AND SIGN BELOW

Offeror’s Printed Name \_\_\_\_\_ Position/Title \_\_\_\_\_

Offeror’s Signature \_\_\_\_\_ Date \_\_\_\_\_

Subscribed and sworn to me on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Notary Public

My Commission expires \_\_\_\_\_

***NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL***

**END OF FORM**





**FORM AG**

**PROPOSAL EVALUATION WAIVER**

By submitting a Proposal, the proposer indicated below agrees to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The proposer further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

**NOTE:** The Statement of Affirmation Must Be Notarized.

**STATEMENT OF AFFIRMATION**

“The undersigned affirms that he/she is duly authorized to execute this waiver by the person(s) or business entity making the proposal.”

Firm’s Name \_\_\_\_\_ Address: \_\_\_\_\_

Proposer’s Printed Name \_\_\_\_\_ Position/Title \_\_\_\_\_

Proposer’s Signature \_\_\_\_\_ Date \_\_\_\_\_

Subscribed and sworn to me on this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
Notary Public

My Commission expires \_\_\_\_\_

***NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL.***

**END OF FORM**

**FORM AH**

**AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT**

STATE OF TEXAS                    )  
  )  
COUNTY OF HARRIS                )

**AFFIDAVIT**

This Company, Contractor, or Subcontractor agrees to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and rules and Regulations issued pursuant thereto in order to maintain and insure non-discriminatory employment practices.

SIGNED: \_\_\_\_\_ DATE: \_\_\_\_\_

PRINTED NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

COMPANY: \_\_\_\_\_

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS

COUNTY OF \_\_\_\_\_)

Subscribed and sworn before me on this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
Notary Public

My Commission expires \_\_\_\_\_

***NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL***

**END OF FORM**

**FORM AI**

**FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENT**

\*\*\*\*\*

**CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT**

Cypress-Fairbanks Independent School District

2022 Arnold MS Renovation

Cypress-Fairbanks ISD Proposal Number: 21-10-5708R-RFP

On receipt by the signer of this document of a check from \_\_\_\_\_ (maker of check) in the sum of \$ \_\_\_\_\_ payable to \_\_\_\_\_ (payee or payees of check) and when the check has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common lay payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of **Cypress-Fairbanks Independent School District** (owner) located at \_\_\_\_\_ (location) to the following extent: \_\_\_\_\_ (job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly paying full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date \_\_\_\_\_  
\_\_\_\_\_  
(Company name)

By \_\_\_\_\_ (Signature)  
\_\_\_\_\_  
(Printed/Typed name)  
\_\_\_\_\_  
(Title)

SWORN AND SUBSCRIBED before me at \_\_\_\_\_, this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.  
\_\_\_\_\_  
Notary Public in and for the state of \_\_\_\_\_.

**FORM AI**

**FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENT**

\*\*\*\*\*

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Cypress-Fairbanks Independent School District

2022 Arnold MS Renovation

Cypress-Fairbanks ISD Proposal Number: 21-10-5708R-RFP

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

**UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT**

The signer of this document has been paid and has received a progress payment in the sum of \$ \_\_\_\_\_  
for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_  
(person with whom signer contracted) on the property of Cypress-Fairbanks Independent School District (owner) located at \_\_\_\_\_  
\_\_\_\_\_ (location) to the following extent: \_\_\_\_\_ (job description).

The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent:

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statements(s) or progress payment request(s).

Date \_\_\_\_\_

\_\_\_\_\_ (Company name)

By \_\_\_\_\_ (Signature)

\_\_\_\_\_ (Printed/Typed name)

\_\_\_\_\_ (Title)

SWORN AND SUBSCRIBED before me at \_\_\_\_\_, this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_ Notary Public in and for the state of \_\_\_\_\_.

**FORM AI**

**FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENT**

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CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Cypress-Fairbanks Independent School District

2022 Arnold MS Renovation

Cypress-Fairbanks ISD Proposal Number: 21-10-5708R-RFP

On receipt by the signer of this document of a check from \_\_\_\_\_ (maker of check) in the sum of \$ \_\_\_\_\_ payable to \_\_\_\_\_ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of **Cypress-Fairbanks Independent School District** (owner) located at \_\_\_\_\_ (location) to the following extent: \_\_\_\_\_ (job description).

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted), inclusive of all modifications and changes therein.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date \_\_\_\_\_  
\_\_\_\_\_ (Company name)

By \_\_\_\_\_ (Signature)  
\_\_\_\_\_ (Printed/Typed name)  
\_\_\_\_\_ (Title)

SWORN AND SUBSCRIBED before me at \_\_\_\_\_, this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.  
\_\_\_\_\_ Notary Public in and for the state of \_\_\_\_\_.

**FORM AI**

**FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENT**

\*\*\*\*\*

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Cypress-Fairbanks Independent School District

2022 Arnold MS Renovation

Cypress-Fairbanks ISD Proposal Number: 21-10-5708R-RFP

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

**UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT**

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to \_\_\_\_\_ (person with whom signer contracted) on the property of **Cypress-Fairbanks Independent School District** (owner) located at \_\_\_\_\_ (location) to the following extent: \_\_\_\_\_ (job description). The signer therefore waives and releases any mechanic’s lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer’s position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer’s laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date \_\_\_\_\_

\_\_\_\_\_ (Company name)

By \_\_\_\_\_ (Signature)

\_\_\_\_\_ (Printed/Typed name)

\_\_\_\_\_ (Title)

SWORN AND SUBSCRIBED before me at \_\_\_\_\_, this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_ Notary Public in and for the state of \_\_\_\_\_.

**FORM AJ**  
**WARRANTY CERTIFICATE**

PROJECT NAME: 2022 Arnold MS Renovation  
Cypress-Fairbanks I.S.D. Proposal Number: 21-10-5708R-RFP  
Architect's Project Number: 220023  
Address: \_\_\_\_\_

**OWNER NAME:** *Cypress-Fairbanks Independent School District* **Phone No.** *(281) 897-4108*

\_\_\_\_\_ Warrants \_\_\_\_\_  
(Name of Company) (Description of Work/Products/ Division Number)

\_\_\_\_\_ against defective materials, workmanship, machinery, hardware, and equipment. The above-mentioned company agrees to repair or replace such defective items at its own expense for a period of \_\_\_\_\_ year/s from the Date of Substantial Completion.

**FIRM ISSUING WARRANTY:** \_\_\_\_\_ **Phone No.** \_\_\_\_\_

**Address:** \_\_\_\_\_ **City** \_\_\_\_\_ **State** \_\_\_\_\_ **Zip** \_\_\_\_\_

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, the name and Corporate Seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing body.

\_\_\_\_\_  
(Printed Name) (Signature) (Title)

(Seal, if a Corporation)  
State whether Corporation,  
Partnership or Individual

Subscribed and sworn before me on this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
Notary Public

My Commission expires \_\_\_\_\_

**FORM AK**

**AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT**

Complete this form and return to the Architect upon close-out of the project.

PROJECT NAME: 2022 Arnold MS Renovation

Cypress-Fairbanks I.S.D. Proposal Number: 21-10-5708R-RFP

Architect's Project Numbers: 220023

OWNER NAME: Cypress-Fairbanks Independent School District

Phone No. (281) 897-4108

Address: 11440 Matzke Rd., Cypress, Texas 77429

The undersigned affirms and certifies that to the best of their knowledge and belief asbestos-, lead-, and PCB- containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems, including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibs, as applicable to the project. Lead sheet flashing used in through roof plumbing penetration applications is the only permissible lead-containing material on the Project.

SIGNED: \_\_\_\_\_

DATE: \_\_\_\_\_

PRINTED NAME: \_\_\_\_\_

TITLE: \_\_\_\_\_

COMPANY: \_\_\_\_\_

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS

COUNTY OF \_\_\_\_\_)

Subscribed and sworn before me on this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
Notary Public

My Commission expires \_\_\_\_\_

**END OF FORM**



**FORM AL**

**CERTIFICATION  
 OF PROJECT  
 COMPLIANCE**

**Distribution to:**

District	<input type="checkbox"/>	Architect/Engineer	<input type="checkbox"/>
Contractor	<input type="checkbox"/>	Texas Education Agency	<input type="checkbox"/>
Other	<input type="checkbox"/>	Building Department	<input type="checkbox"/>

**1. PROJECT INFORMATION:**  
 2022 Arnold MS Renovation

**ARCHITECT/ENGINEER:**  
 PBK Architect

**CONTRACTOR/CM:**

**PROJECT NUMBER:** 21-10-5708R-RFP

**CONTRACT DATE:**

**DISTRICT:** Cypress-Fairbanks Independent School District  
 11440 Matzke Rd.  
 Cypress, Texas 77429

**DATE DISTRICT AUTHORIZES PROJECT:**

**BRIEF DESCRIPTION OF PROJECT:** The Project consists of renovations/new \_\_\_\_\_.

**2. CERTIFICATION OF DESIGN AND CONSTRUCTION**

The intent of this document is to assure that the school district has provided to the Architect/Engineer the required information and the Architect/Engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the Contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

**3. The District** certifies that the enrollment projections, educational specifications and objectives of this facility along with the identified building code to be used have been provided to the Architect/Engineer.

**DISTRICT:** Cypress-Fairbanks I.S.D.                      **BY:** \_\_\_\_\_                      **DATE:** \_\_\_\_\_

**4. The Architect/Engineer** certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the State Board of Education, July 1992, and as provided by the district.

**ARCHITECT:** PBK Architect                      **BY:** \_\_\_\_\_                      **DATE:** \_\_\_\_\_

**5. The Contractor/CM** certifies that this project has been constructed in general conformance with the construction documents as prepared by the Architect/Engineer listed above.

**CONTRACTOR:** \_\_\_\_\_                      **BY:** \_\_\_\_\_                      **DATE:** \_\_\_\_\_

**5. The District** certifies to completion of the project (as defined by the Architect/Engineer and Contractor).

**DISTRICT:** Cypress-Fairbanks I.S.D.                      **BY:** \_\_\_\_\_                      **DATE:** \_\_\_\_\_

**INSTRUCTIONS FOR COMPLETION OF “CERTIFICATION OF PROJECT COMPLIANCE” FORM**

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Section 1. Identify the following:

- name and address of the school facility
- the Architect/Engineer and Contractor
- the school district’s project number (if applicable)
- the date of execution of the construction contract
- name, address, and telephone number of the school district
- the date that the school district authorized the superintendent to hire an Architect/Engineer
- scope of the project.

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Section 2. This section outlines the intent of the document. No action required.

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Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

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Section 4. This section is to be executed by the Architect/Engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.104, School Facilities Standards) and returned to the school district’s files.

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Section 5. This section is to be executed by the Contractor upon substantial completion of the project and retained in the school district’s files.

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Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

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NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

**END OF FORM**



**SECTION AN**

**Conflict of Interest Questionnaire**

According to Local Government Code, Chapter 176, a person or an agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with Cypress-Fairbanks Independent School District must file a completed Conflict of Interest Questionnaire with the Purchasing Department not later than the seventh business day after the date that the person begins contract discussions or negotiations with the District or submits to the District an application, response to a request for proposals or bids, correspondence, or another writing related to a potential agreement with the District.

Each Proposer must complete the on-line version of the Conflict Of Interest Questionnaire at the following website:

<https://app.cfsd.net/ciq/index.aspx>

Full instructions for completing the Questionnaire are included at this website.

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**CERTIFICATION OF PROPOSER'S COMPLETION OF CONFLICT OF INTEREST QUESTIONNAIRE**

The undersigned certifies that he has completed the Conflict of Interest Questionnaire per the above information.

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

(Seal, if a Corporation)  
State whether Corporation,  
Partnership or Individual

\_\_\_\_\_  
Name of Contracting Firm

\_\_\_\_\_  
Address

\_\_\_\_\_  
Telephone

\_\_\_\_\_  
Date

**TO BE INITIALED BY ARCHITECT AND CONTRACTOR PRIOR TO OWNER'S FINAL CLOSEOUT REVIEW**

**PROJECT NAME:**

**NOTE: SUBMIT ALL DOCUMENTS RELATED TO SUBCONTRACTORS AND SUPPLIERS IN ALPHABETICAL ORDER BY NAME OF COMPANY UNLESS NOTED OTHERWISE**

	<u>Contractor's Initials</u>	<u>Architect's Initials</u>	<u>CFISD PM Initials</u>
CFISD Close Out Log - with Subcontractors Filled Out	_____	_____	_____
List of Project Team	_____	_____	_____
List of Final Subcontractor/Suppliers/Local Representatives ( <b>Form AF</b> )	_____	_____	_____
"Consent of Surety to Final Payment" <b>AIA G707</b> <input type="checkbox"/> 1. Check for Corporate Seal <input type="checkbox"/> 2. Check for Original Signature <input type="checkbox"/> 3. Check for Project Name	_____	_____	_____
"Contractor's Affidavit of Payment of Debts and Claims" <b>AIA G706</b> <input type="checkbox"/> 1. Check for Notary <input type="checkbox"/> 2. Check for Original Signature <input type="checkbox"/> 3. Check for Project Name	_____	_____	_____
"Contractor's Affidavit of Release of Liens" <b>AIA G706A</b> <input type="checkbox"/> 1. Check for Notary <input type="checkbox"/> 2. Check for Original Signature <input type="checkbox"/> 3. Check for Project Name	_____	_____	_____
Subcontractors' Waiver of Lien (Subcontractors/Major Suppliers) <b>(Conditional or Unconditional) (Form AI)</b> <input type="checkbox"/> 1. Check against Subcontractor List <input type="checkbox"/> 2. Check for Notary <input type="checkbox"/> 3. Check for Original Signature <input type="checkbox"/> 4. Check for Project Name	_____	_____	_____
"Certificate of Substantial Completion" <b>AIA G704</b>	_____	_____	_____
Allowances <input type="checkbox"/> 1. <i>CPR Execution Complete (Owner)</i> <input type="checkbox"/> 2. <i>Account Balance Review (Owner)</i> <input type="checkbox"/> 3. Executed Final Change Order	_____	_____	_____
Architect letter confirming all punch list items complete ( <b>Architect</b> ) <input type="checkbox"/> 1. Final Signed Off Punch list	_____	_____	_____
List of All Permits during Job and a Copy of All Permits	_____	_____	_____
Storm Water Quality Permit (As-Built Certificate) <input type="checkbox"/> 1. Check for Original Signature <input type="checkbox"/> 2. Check for Project Name <input type="checkbox"/> 3. Check for Permit Number <input type="checkbox"/> 4. Check for Engineer License Seal	_____	_____	_____

**PROJECT CLOSE OUT – FORM AO**

	<u>Contractor's Initials</u>	<u>Architect's Initials</u>	<u>CFISD PM Initials</u>
Utilities ( <b>Owner</b> )	_____	_____	_____
<input type="checkbox"/> Invoice/Check for Electricity			
<input type="checkbox"/> Invoice/Check for Gas			
<input type="checkbox"/> Invoice/Check for Water/Sewer/Irrigation			
Contractor's Overtime	_____	_____	_____
<input type="checkbox"/> Invoices Sent to Contractor (Owner)			
<input type="checkbox"/> Payment Received by Contractor (Owner)			
Copy of Certificate of Compliance/Occupancy from local governmental Authorities	_____	_____	_____
Project Compliance Certificate ( <b>Owner Form AL</b> )	_____	_____	_____
<input type="checkbox"/> 1. Check for Original Signature			
<input type="checkbox"/> 2. Check for Project Name			
Hazardous Material Certificate (Architect, General Contractor/Contractor, Subcontractors, and Material/Equipment Suppliers) Each shall be notarized. ( <b>Form AK</b> )	_____	_____	_____
<input type="checkbox"/> 1. Check against Subcontractor List			
<input type="checkbox"/> 2. Check for Notary			
<input type="checkbox"/> 3. Check for Project Name			
<input type="checkbox"/> 4. Check for Original Signature			
Asbestos Manifest	_____	_____	_____
<input type="checkbox"/> Signed by all appropriate parties			
Report from Asbestos Consultant confirming abatement observations and air monitoring	_____	_____	_____
<input type="checkbox"/> 1. Asbestos Reports			
<input type="checkbox"/> 2. <i>Transmit Originals to Maintenance, Keep Copies for File. (Owner)</i>			
Letter from Building Envelope Consultant confirming all deficiency items complete	_____	_____	_____
Roofing Warranty & Documentation	_____	_____	_____
<input type="checkbox"/> <i>Send Copies to Director of Maintenance (Owner)</i>			
<input type="checkbox"/> Compliance letter on Roofing from Roofing Consultant			
<input type="checkbox"/> Roofing Manufacturer Letter confirming Warranty			
<input type="checkbox"/> Copy to Roof Warranty Binder (Owner)			
<input type="checkbox"/> Place Original in Roof Warranties Binder (Owner)			
TDLR Inspection	_____	_____	_____
<input type="checkbox"/> Inspection Report			
<input type="checkbox"/> Deficiencies documented and corrected (if applicable)			
<input type="checkbox"/> Approval letter from TDLR			
Letter from Test & Balance Consultant confirming all deficiency items complete	_____	_____	_____
Letter from Commissioning Consultant confirming all deficiency items complete	_____	_____	_____
Letter from Structural Engineer confirming conformance with design ( <b>provided by Architect</b> )	_____	_____	_____
Letter from Civil Engineer confirming conformance with design ( <b>provided by Architect</b> )	_____	_____	_____

**PROJECT CLOSE OUT – FORM AO**

	<u>Contractor's Initials</u>	<u>Architect's Initials</u>	<u>CFISD PM Initials</u>
Letter from Mechanical Engineer confirming conformance with design <b>(provided by Architect)</b>	_____	_____	_____
Letter from Materials Testing Consultant confirming all deficiency items complete	_____	_____	_____
Letter from Consultants confirming conformance with design if applicable <b>(Provided by Consultant, FDP, C-H, etc.)</b>	_____	_____	_____
Copy of all Gas Pipe Test Results Form	_____	_____	_____
Elevators	_____	_____	_____
<input type="checkbox"/> Maintenance Service Agreement			
<input type="checkbox"/> Send Copy to Maintenance (Owner)			
General Contractor's Written Guarantee <b>(Form AJ)</b>	_____	_____	_____
<input type="checkbox"/> 1. Check for Notary			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
Subcontractors' Written Guarantee <b>(Form AJ)</b>	_____	_____	_____
<input type="checkbox"/> 1. Check against Subcontractor List			
<input type="checkbox"/> 2. Check for Original Signature			
<input type="checkbox"/> 3. Check for Project Name			
<input type="checkbox"/> 4. Check for Notary			
<input type="checkbox"/> 5. State date to be date of Substantial Completion of final phase of project			
Extended Warranties & Maintenance List	_____	_____	_____
Insurance Certificate documenting continuing coverage after Final Payment <b>(see AIA Document A201™-2017, as amended, Article 11.1.3)</b>	_____	_____	_____
Workers' Compensation Certificates	_____	_____	_____
<input type="checkbox"/> General Contractor			
<input type="checkbox"/> <u>ALL</u> Subcontractors			
All Extra Stock Transmittals by Division	_____	_____	_____
<input type="checkbox"/> Divisions 0 – 21			
<input type="checkbox"/> Division 22 Plumbing			
<input type="checkbox"/> Division 23 HVAC			
<input type="checkbox"/> Division 26 Electrical			
<input type="checkbox"/> Division 27, 28 and beyond as applicable			
CFISD Master Keys Returned	_____	_____	_____
Paint Mix Cards	_____	_____	_____
List of Finishes used in Project	_____	_____	_____
Demonstration and Training Sign In Sheets by Division with Digital Video if applicable	_____	_____	_____

**PROJECT CLOSE OUT – FORM AO**

Contractor's Initials   Architect's Initials   CFISD PM Initials

Maintenance/Operations Manuals (2 hard copies, 1 digital copy)  
(Reviewed/Approved by Architect)

- Divisions 0 – 21
- Division 22 Plumbing
- Division 23 HVAC
- Division 26 Electrical
- Division 27, 28 and beyond as applicable

\_\_\_\_\_

Record Drawings / As-Builts

- 1. Record CAD Files
- 2. Record PDF Files

\_\_\_\_\_

The undersigned Contractor certifies that to the best of the Contractor’s knowledge, information and belief the close out documentation attached has been accurately completed in accordance with the Contract Documents, and requests permission to submit the FINAL Application and Certification for Payment AIA G702 Document for the outstanding retainage owed under the contract.

**Contractor:**

By: \_\_\_\_\_

Print Name: \_\_\_\_\_

In accordance with the Contract Documents, based on data comprising the attached, the Architect certifies to the Owner that to the best of the Architect’s knowledge, information and belief the Project Close Out Documents have been completed as indicated, the accuracy of the documents is in accordance with the Contract Documents.

**Architect:**

By: \_\_\_\_\_

Print Name: \_\_\_\_\_

CFISD Project Manager Signature: \_\_\_\_\_ Date: \_\_\_\_\_

CFISD Director of Project Management Signature: \_\_\_\_\_ Date: \_\_\_\_\_

CFISD Director of Contract Management Signature: \_\_\_\_\_ Date: \_\_\_\_\_

CFISD Assistant Superintendent Signature: \_\_\_\_\_ Date: \_\_\_\_\_



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## FORM AP – Contractor SB 9 Public Works Contractor Certification

**Introduction:** Texas Education Code Chapter 22 requires entities that contract with school district contractors to obtain criminal history record information regarding covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Contractors must certify to the District that they have complied.

The District may not obtain criminal histories for contractors: The law requires each contractor to obtain the criminal histories of its covered employees.

**Definitions:**

*Covered employees:* Employees of a contractor who have or will have continuing duties related to the service to be performed at the District and have or will have the opportunity for direct contact with students in connection with the person's continuing duties. The District will be the final arbiter of what constitutes *continuing duties* or *direct contact* with students. *Disqualifying criminal history:* (1) a conviction or other criminal history information designated by the District or (2) a conviction for one of the following offenses during the preceding 30 years, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; (c) an equivalent offense under federal law or the laws of another state. Title 5 felony offenses include criminal homicide; kidnapping, unlawful restraint, and smuggling of persons; trafficking of persons; sexual offenses; and assaultive offenses.

---

On behalf of \_\_\_\_\_ ("Contractor"), I, the undersigned authorized signatory for Contractor, certify to Cypress-Fairbanks Independent School District ("District") and Contractor that [check one]:

None of Contractor's employees are *covered employees*, as defined above. If this box is checked, I further certify that Contractor has taken precautions or imposed conditions to ensure that its employees will not become *covered employees*. Contractor will maintain these precautions or conditions throughout the time the contracted services are provided.

Or

Some or all of Contractor's employees are *covered employees*. If this box is checked, I further certify that:

- 1) Contractor has obtained all required criminal history record information regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- 2) If Contractor receives information that a covered employee subsequently has a reported criminal history, Contractor will immediately remove the covered employee from contract duties and notify the District in writing with 3 business days.
- 3) Upon request, Contractor will provide the District with the name and any other requested information of covered employees so that the District may obtain criminal history record information on the covered employees.

All company employees must have a CFISD badge prior to working on district property.

There is a processing fee of \$7 per badge requested, for which an invoice will be submitted. This fee is a processing fee per individual submitted on the Employee List Form and is charged regardless of whether the individual is approved to receive a badge.

If the District objects to the assignment of a covered employee based on the covered employee's criminal history record information, Contractor agrees to discontinue using that covered employee to provide services at the District.

I also certify to the District on behalf of Contractor that Contractor has obtained certifications from its subcontractors of compliance with Education Code, Chapter 22.

Noncompliance or misrepresentation regarding this certification may be grounds for contract termination.

---

Signature

Date

---

Title

Submit completed form to: Cypress-Fairbanks ISD, Facilities & Construction Office: [contractor\\_badges@cfisd.net](mailto:contractor_badges@cfisd.net)

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**Notes**

Public works contractor employees must have opportunity for *direct contact with students* in order to be subject to a mandatory criminal history review. Tex. Educ. Code § .08341(b)(2). Direct contact with students is contact that results from activities that provide substantial opportunity for verbal or physical interaction with students and that is not supervised by a certified educator or other professional district employee.

For public works contractor employees, a person does not have the opportunity for direct contact with students if:

- the public work does not involve the construction, alteration, or repair of an instructional facility;
- if the public work involves construction of a *new* instructional facility, the person's duties related to the contracted services will be completed not later than the seventh day before the first date the facility will be used for instructional purposes; *or*
- if the public work involves an existing instructional facility:
  - the public work area contains sanitary facilities and is separated from all areas used by students by a secure barrier fence that is not less than six feet in height; *and*
  - the contractor adopts a policy prohibiting employees, including subcontractor employees, from interacting with students or entering areas used by students, informs employees of the policy, and enforces the policy at the public work area.

"Instructional facility" means real property, an improvement to real property, or a necessary fixture of an improvement to real property that is used predominantly for teaching the curriculum required under Texas Education Code section 28.002.

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## FORM AP - Subcontractor SB 9 Public Works Contractor Certification

**Introduction:** Texas Education Code Chapter 22 requires entities that contract with school district contractors to obtain criminal history record information regarding covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Subcontractors must certify to the District and to the contractor that they have complied.

The District may not obtain criminal histories for subcontractors: The law requires each subcontractor to obtain the criminal histories of its covered employees.

**Definitions:**

*Covered employees:* Employees of a subcontractor who have or will have continuing duties related to the service to be performed at the District and have or will have the opportunity for direct contact with students in connection with the person's continuing duties. The District will be the final arbiter of what constitutes *continuing duties* or *direct contact* with students. *Disqualifying criminal history:* (1) a conviction or other criminal history information designated by the District or (2) a conviction for one of the following offenses during the preceding 30 years, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; (c) an equivalent offense under federal law or the laws of another state. Title 5 felony offenses include criminal homicide; kidnapping, unlawful restraint, and smuggling of persons; trafficking of persons; sexual offenses; and assaultive offenses.

---

Subcontractor has entered a contract with \_\_\_\_\_ ("Contractor") to provide services in connection with contract between Cypress-Fairbanks Independent School District ("District") and Contractor. On behalf of \_\_\_\_\_ ("Subcontractor"), I, the undersigned authorized signatory for Subcontractor, certify to the District and Contractor that [check one]:

None of Subcontractor's employees are *covered employees*, as defined above. If this box is checked, I further certify that Subcontractor has taken precautions or imposed conditions to ensure that its employees will not become *covered employees*. Subcontractor will maintain these precautions or conditions throughout the time the contracted services are provided.

Or

Some or all of Subcontractor's employees are *covered employees*. If this box is checked, I further certify that:

- 1) Subcontractor has obtained all required criminal history record information regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- 2) If Subcontractor receives information that a covered employee subsequently has a reported criminal history, Subcontractor will immediately remove the covered employee from contract duties and notify the District in writing with 3 business days.
- 3) Upon request, Subcontractor will provide the District with the name and any other requested information of covered employees so that the District may obtain criminal history record information on the covered employees.

All company employees must have a CFISD badge prior to working on district property.

There is a processing fee of \$7 per badge requested, for which an invoice will be submitted. This fee is a processing fee per individual submitted on the Employee List Form and is charged regardless of whether the individual is approved to receive a badge.

If the District objects to the assignment of a covered employee based on the covered employee's criminal history record information, Subcontractor agrees to discontinue using that covered employee to provide services at the District.

I also certify to the District and Contractor on behalf of Subcontractor that Subcontractor has obtained certifications from its subcontractors of compliance with Education Code, Chapter 22.

Noncompliance or misrepresentation regarding this certification may be grounds for contract termination.

---

Signature

---

Date

---

Title

Submit completed form to: Cypress-Fairbanks ISD, Facilities & Construction Office: [contractor\\_badges@cfisd.net](mailto:contractor_badges@cfisd.net)

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**Notes**

Public work subcontractor employees must have opportunity for *direct contact with students* in order to be subject to a mandatory criminal history review. Tex. Educ. Code § .08341(b)(2). Direct contact with students is contact that results from activities that provide substantial opportunity for verbal or physical interaction with students and that is not supervised by a certified educator or other professional district employee.

For public works subcontractor employees, a person does not have the opportunity for direct contact with students if:

- the public work does not involve the construction, alteration, or repair of an instructional facility;
- if the public work involves construction of a *new* instructional facility, the person's duties related to the contracted services will be completed not later than the seventh day before the first date the facility will be used for instructional purposes; *or*
- if the public work involves an existing instructional facility:
  - the public work area contains sanitary facilities and is separated from all areas used by students by a secure barrier fence that is not less than six feet in height; *and*
  - the contractor adopts a policy prohibiting employees, including subcontractor employees, from interacting with students or entering areas used by students, informs employees of the policy, and enforces the policy at the public work area.

"Instructional facility" means real property, an improvement to real property, or a necessary fixture of an improvement to real property that is used predominantly for teaching the curriculum required under Texas Education Code section 28.002.



## Cypress-Fairbanks Independent School District Employee List Form

### **FORM AP - CERTIFICATION OF CRIMINAL HISTORY RECORD INFORMATION** For Contractors, Sub-Contractors, Service Providers, & Vendors

Project Name: \_\_\_\_\_

Date: \_\_\_\_\_

Project Number: \_\_\_\_\_

CFISD Project Manager: \_\_\_\_\_

Company Name: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Phone: \_\_\_\_\_

\_\_\_\_\_

**PLEASE TYPE OR PRINT CLEARLY**

Filled out by Service Provider					For CFISD Use	
Employee Name <i>(Last Name, First Name)</i>	Gender <i>(Male, Female)</i>	Birth Date <i>(Month, Day, Year)</i>	Race	U.S Government Issued Picture ID Number and Type	V-Soft Cleared <i>(Sign &amp; Date)</i>	Badge Issued <i>(Sign &amp; Date)</i>

FACILITIES PLANNING AND CONSTRUCTION

## CERTIFICATE OF FINAL COMPLETION (AQ)

Project Name:	2022 Arnold MS Renovation	Project No.:	220023
Contractor:			
Contract No.:	21-10-5708R-RFP	Contract Date:	
Architect/Engineer:	PBK Architect		
Date of Final Completion:		Time of Final Completion (include Time Zone CT):	

**DATE OF FINAL COMPLETION**

The work performed under this contract has been inspected and found to be complete. This constitutes the Owner's acceptance for final completion for the **ENTIRE** contract amount. The date of final completion of the project is hereby established as set forth above.

In accordance with the General Conditions and Supplementary Conditions of the contract, this is to confirm the results of the final completion inspection(s). The Contractor has completed the list of items identified on the pre-final and final punch list(s) that the inspection team required corrected or completed before final acceptance of the work in accordance with the contract. Work accepted with incomplete punch list items or failure of the Owner or other parties to identify work that does not comply with the contract documents or is defective in operation or workmanship does not constitute a waiver of the Owner's rights under the contract or relieve the Contractor of its responsibility for performance or warranties.

In accordance with the contract, the date of final completion is that date jointly certified by the Contractor, Architect/Engineer and Owner that the work is completed and the contract is fully satisfied according the contract documents. Completion of all work is a condition precedent to the Contractor's right to receive final payment.

The **CONTRACTOR** has completed/corrected the items identified on all referenced punch list(s) and the requirements of the contract are fully satisfied according to the contract documents.

<i>Project Manager</i>	<i>(Print Name)</i>	<i>(Date)</i>

The **ARCHITECT** agrees that the work noted in this Certificate of Final Completion is completed in accordance with the contract documents.

<i>Project Architect</i>	<i>(Print Name)</i>	<i>(Date)</i>

The **OWNER** accepts the work designated herein to be in accordance with the requirements for final completion, except as provided in the contract documents.

<i>Project Manager</i>	<i>(Print Name)</i>	<i>(Date)</i>

<i>Director of Construction Field Services</i>	<i>(Print Name)</i>	<i>(Date)</i>

<i>Director of Project Management</i>	<i>(Print Name)</i>	<i>(Date)</i>

<i>Director of Contract Management</i>	<i>(Print Name)</i>	<i>(Date)</i>

<i>Assistant Supt. of Facilities &amp; Construction</i>	<i>(Print Name)</i>	<i>(Date)</i>

<i>Chief Operations Officer</i>	<i>(Print Name)</i>	<i>(Date)</i>

*Associate Supt. of Facilities, Construction & Support Services*

## SECTION AR

### DISCLOSURE OF INTERESTED PARTIES

Section 2252.908 of the Texas Government Code requires a business entity that enters into a contract with a school district must submit a disclosure of interested parties (Form 1295) to the school district and state agency and applies to contracts with a value of \$1,000,000.00 or greater and applies to all contracts entered into on or after January 01, 2016.

An example of the Form 1295 is included in this section; however the form shall be required to be filled out online, printed and signed, and submitted with the contract of which it is applicable.

#### Filing Process:

By January 01, 2016, the Texas Ethics Commission will make available on its website a new filing application that must be used to file Form 1295. A business entity must use the application to enter the required information on Form 1295 and print a copy of the form and a separate certification of filing that will contain a unique certification number. An authorized agent of the business entity must sign the printed copy of the form and have the form notarized. The completed Form 1295 and certification of filing must be filed with the governmental body or state agency with which the business entity is entering into the contract.

The governmental entity or state agency must notify the commission, using the commission's filing application, of the receipt of the filed Form 1295 and certification of filing not later than the 30<sup>th</sup> day after the date the contract binds all parties to the contract. The commission will post the completed Form 1295 to its website within seven business days after receiving notice from the governmental entity or state agency.

Information regarding how to use the filing application will be available on the Texas Ethics Commissions site by January 01, 2016 at [www.ethics.state.tx.us](http://www.ethics.state.tx.us).

<b>CERTIFICATE OF INTERESTED PARTIES</b>		<b>FORM 1295</b>	
Complete Nos. 1 - 4 and 6 if there are interested parties. Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.		<b>OFFICE USE ONLY</b>	
<b>1</b> Name of business entity filing form, and the city, state and country of the business entity's place of business.		Must file online at <a href="http://www.ethics.state.tx.us/File">www.ethics.state.tx.us/File</a>	
<b>2</b> Name of governmental entity or state agency that is a party to the contract for which the form is being filed.			
<b>3</b> Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.			
4		Nature of Interest (check applicable)	
Name of Interested Party	City, State, Country (place of business)	Controlling	Intermediary
<b>5</b> Check only if there is NO Interested Party. <input type="checkbox"/>			
<b>6 UNSWORN DECLARATION</b> My name is _____, and my date of birth is _____. My address _____ (street) _____ (city) _____ (state) _____ (zip code) _____ (country). I declare under penalty of perjury that the foregoing is true and correct. Executed in _____ County, State of _____, on the _____ day of _____, 20____. <span style="float: right;">(month) (year)</span>			
_____ Signature of authorized agent of contracting business entity (Declarant)			
<b>ADD ADDITIONAL PAGES AS NECESSARY</b>			



**DOCUMENT BA**

**CONTRACT DOCUMENTS**

**I. CONSTRUCTION CONTRACT AGREEMENT**

- A. The contract for the construction of the project shall be executed by the successful Offeror on the AIA Document A101™-2017, as amended "Standard Form of Agreement between Owner and Contractor." A Notice to Proceed shall be issued 10 days following Board Award.
- B. A sample of this AIA Document A101™-2017, as amended is attached here within.

**II. CONDITIONS OF THE CONTRACT**

- A. General Conditions:
  - 1. The General Conditions of the Contract for Construction AIA Document A201™-2017, as supplemented and amended herein, constitutes the General Conditions and is hereby specifically made part of the Contract Documents.
- B. Supplementary Conditions:
  - 1. For modifications to the General Conditions of the Contract for Construction AIA Document A201™-2017, as amended refer to Section CB for the Supplementary Conditions.

**END OF DOCUMENT**

**FORM BB**

**TEXAS STATUTORY PERFORMANCE BOND**  
(Penalty of this bond must be 100% of contract amount)

**Bond No.:** \_\_\_\_\_

KNOW ALL MEN BY THESE PRESENTS, that: \_\_\_\_\_  
(hereinafter called the Principal), as Principal, and \_\_\_\_\_  
a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized and  
admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter  
called the Surety), as Surety, are held and firmly bound unto

\_\_\_\_\_  
\_\_\_\_\_

(hereinafter called the Obligee) in the amount of \_\_\_\_\_

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves, and  
their heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated this \_\_\_\_\_ day  
of \_\_\_\_\_, \_\_\_\_\_.

**2022 ARNOLD MS RENOVATION  
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT  
CYPRESS-FAIRBANKS I.S.D. PROPOSAL NUMBER: 21-10-5708R-RFP**

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully  
perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be  
void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas  
Government Code and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter  
to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this \_\_\_\_\_  
day of \_\_\_\_\_, \_\_\_\_\_.

\_\_\_\_\_  
\_\_\_\_\_  
Principal (Seal)

Surety Address \_\_\_\_\_  
By: \_\_\_\_\_  
Signature and Printed Name

\_\_\_\_\_  
\_\_\_\_\_  
Surety (Seal)

Surety Telephone Number \_\_\_\_\_  
By: \_\_\_\_\_  
Attorney-in-Fact: Signature and Printed Name

**FORM BC**

**TEXAS STATUTORY PAYMENT BOND**      **Bond No.:** \_\_\_\_\_  
(Penalty of this bond must be 100% of contract amount)

KNOW ALL MEN BY THESE PRESENTS, that: \_\_\_\_\_  
(hereinafter called the Principal), as Principal, \_\_\_\_\_  
a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized and  
admitted to do business in the State of Texas and licensed by the State of Texas to execute bonds as Surety (hereinafter  
called the Surety), as Surety, are held and firmly bound unto

\_\_\_\_\_  
\_\_\_\_\_  
(hereinafter called the Obligee) in the amount of \_\_\_\_\_

\_\_\_\_\_  
Dollars (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves, and  
their heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated this \_\_\_\_\_ day  
of \_\_\_\_\_, \_\_\_\_\_.

**2022 ARNOLD MS RENOVATION  
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT  
CYPRESS-FAIRBANKS I.S.D. PROPOSAL NUMBER: 21-10-5708R-RFP**

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall pay all  
claimants supplying labor and material to him or a Subcontractor in the prosecution of the work provided for in said  
contract, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 22.53 of the Texas  
Government Code and all liabilities on this bond to all such claimants shall be determined in accordance with the  
provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this \_\_\_\_\_  
day of \_\_\_\_\_, \_\_\_\_\_.

Witness: \_\_\_\_\_ (Seal)  
Principal

\_\_\_\_\_ By: \_\_\_\_\_  
Signature and Printed Name

Witness: \_\_\_\_\_ (Seal)  
Surety

\_\_\_\_\_ By: \_\_\_\_\_  
Attorney-in-Fact: Signature and Printed Name

\_\_\_\_\_ Surety Address  
\_\_\_\_\_ Surety Telephone Number

## SECTION BD

### INSURANCE AND BONDS REQUIREMENTS FOR CONTRACTORS AND FACILITY RENTERS

#### CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT INSURANCE MANAGEMENT

#### 1.0 GENERAL

- A. The District shall require that the following insurance requirements be met on public works contracts:
1. No Work will be commenced until all requirements of this Section have been approved by the District in writing.
  2. The District shall be furnished a Declaration of Insurance evidencing all policies and endorsements required by this Section prior to proceeding with any work.
  3. The insurance shall contain a provision that at least thirty days prior written notice shall be given to the District in the event of cancellation, material change, or non-renewal.
  4. Insurance shall be underwritten by a company rated not less than B+ VII in Best's latest published guide.
  5. There shall be a hold harmless agreement in which the Contractor assumes liability on the contract and holds the School District harmless.
  6. The Contractor shall purchase and maintain in force the following kinds of insurance and bonds for operations under construction contracts and as specified in each section.
  7. No deletions/exclusions from standard coverage form are allowed without the written consent of Cypress-Fairbanks Independent School District.
  8. Furnish copies of subcontractors Certificates of Insurance to Owner.
  9. Furnish copies of Worker Compensation Documents to Owner.

#### 2.0 CASUALTY INSURANCE

- A. Worker's Compensation Insurance Coverage

Definitions:

Certificate of coverage ("Certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until one (1) year after Substantial Completion of the project.

Persons providing services on the project ("subcontractor" in Texas Labor Code 406.096) - includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity that furnishes persons to provide services on the project. "Services" shall include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

1. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code 401.011 (44) for all employees of the contractor providing services on the project for the duration of the project.

2. The contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract. The certificate shall show Cypress-Fairbanks Independent School District as the certificate holder. The policy must be endorsed to provide a “waiver of subrogation in favor of Cypress-Fairbanks Independent School District.”
3. If the coverage period shown on the contractor’s current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing the coverage has been extended.
4. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:
  - a. a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on a project; and
  - b. no later than seven (7) days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
5. The contractor shall retain all required certificates of coverage for the duration of the project and two (2) years thereafter.
6. The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knows or should know, of any change that materially affects the provision of coverage of any person providing services on the project.
7. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers’ Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.
8. The contractor shall contractually require each person with whom it contracts to provide services on a project, to:
  - a. provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011 (44) for all of its employees providing services on the project, for the duration of the project. The policy must be endorsed to provide a “waiver of subrogation” in favor of Cypress-Fairbanks Independent School District;
  - b. provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project. The certificate shall show Cypress-Fairbanks Independent School District as the certificate holder;
  - c. provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
  - d. obtain from each other person with whom it contracts, and provide to the contractor:
    - 1) a certificate of coverage, prior to the other person beginning work on the project; and

- 2) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project.
  - e. retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
  - f. notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provisions of coverage of any person providing services on the project; and
  - g. contractually require each person with whom it contracts to perform as required by paragraphs a - g, with the certificates of coverage to be provided to the person for whom they are providing services.
9. By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
10. The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.
11. The Contractor shall post the following language:

**REQUIRED WORKERS' COMPENSATION COVERAGE**

"The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee." Furnish copies of Workers' Compensation coverage for each person working on the project.

"Call the Texas Workers' Compensation Commission at (512) 440-3789 to receive information on the legal requirements for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

**B. Commercial General Liability Insurance (Occurrence basis only).**

Each Occurrence Limit		\$1,000,000 CSL
Products/Completed Operations	Aggregate	\$1,000,000
Personal and Advertising Injury	Occurrence	\$1,000,000
Fire Damage, Legal Liability	Any one fire	\$50,000
Medical Expenses	Any one person	\$5,000

- C. The Owner shall be named as an additional insured by endorsement on the Contractor's policy as to the subject job.

**2.1 AUTOMOBILE LIABILITY INSURANCE**

- A. Business (Commercial) Automobile Liability Insurance
  - 1. Coverage for all owned, non-owned and hired vehicles:

Bodily Injury/Property Damage	\$1,000,000 CSL
-------------------------------	-----------------

**2.2 UMBRELLA LIABILITY INSURANCE (EXCESS) \$1,000,000**

- A. The Owner shall be named as an additional insured on the Contractor's policy as to the subject job.
- B. This policy shall provide coverage over the Workmen's Compensation, Commercial General Liability and Business Automobile Liability policies.

**2.3 PROPERTY INSURANCE (BUILDER'S RISK/INSTALLATION FLOATER)**

- A. The policy shall be written in the name of the Owner, Contractor, and subcontractors as their interest may appear.
- B. The policy shall be written on an all risk basis for physical loss or damage and include theft, vandalism, malicious mischief.
- C. The amount of coverage shall be for the full insurable value of work.
- D. The deductible shall not be over \$1,000.00 without the approval of the Owner. (Deductible losses shall be paid by the Contractor.)
- E. The policy shall include an endorsement allowing Owner occupancy, and the insurance shall not be canceled or altered on account of partial occupancy prior to completion.
- F. A subrogation clause shall waive subrogation as to the Contractor, subcontractor, sub-subcontractors, the Owner and his employees and representatives.
- G. The original builders risk policy shall be furnished to the Owner prior to start of the job and maintained through Substantial Completion

**3.0 BONDS**

- A. Bonds are required for public works contracts under the following circumstances:
  - 1. Performance Bond and Labor and Material Payment Bond, each in a personal sum equal to 100% of contract sum if the formal contract is in excess of \$25,000.00.
  - 2. A Proposal Bond or Proposal Security in the amount of 10% of any proposal of \$25,000.00 or more must be submitted with formal proposals on public works contracts or as otherwise specified in each contract.
  - 3. Copies of the bonds shall be filed with the county clerk and the owner shall receive a file receipt.
  - 4. Performance and Payment Bonds shall remain in force for one (1) year after substantial completion.
  - 5. The Work will not be started until the bonds and issuing companies have been accepted in writing as satisfactory by the Owner.
  - 6. The original bonds will be delivered to the Owner with an attached authorized power of attorney.

**END OF DOCUMENT**

**SECTION CA  
APPLICATION AND CERTIFICATION FOR PAYMENT  
CHECK LIST AND TRANSMITTAL**

Date: \_\_\_\_\_ Application for Payment No.: \_\_\_\_\_  
 Project: 2022 Arnold MS Renovation Architect's Proposal Number: 220023  
 Owner: Cypress-Fairbanks Independent School District Architect: PBK Architect  
 Contractor: \_\_\_\_\_

Transmitted herewith is one (1) completed copy of the above referenced Application and Certificate for Payment. By initialing each item listed below, the undersigned certifies that he/she has personally checked and determined that each of the items is in compliance with the requirements of the Contract Documents.

Item	Description	CONTRACTOR Initial to Acknowledge Compliance	ARCHITECT Initial to Acknowledge Compliance	OWNER Initial to Acknowledge Compliance	Notes, Exceptions
A	One (1) complete copy of the above Referenced Application and Certificate for Payment, signed and Notarized, are enclosed.				
B	The grand totals of the Continuation Sheet match the amounts shown on the Application and Certificate for Payment.				
C	Percentage drawn for Supervision and General Conditions is less than or equal to the Continuation Sheet grand total percentage complete.				
D	Unconditional Release for each lien or claim that is applicable to period covered in Previously Approved Pay Application. Release must identify exact amount and period as stated in the Application for Payment.				
E	Conditional Release for each lien or claim that is applicable to period covered in Current Pay Application. Release must identify exact amount and period as stated in the Application for Payment.				
F	One (1) copy of Stored Materials Inventory List and Invoices enclosed for each line item of stored materials.				
G	One (1) updated Construction Schedule enclosed.				
H	Recovery Plan from GC if project is behind schedule.				
I	Anticipated Weather Delay Log				
J	Construction Progress Photographs enclosed.				
K	Back charges are paid to date (e.g. Operations (Custodial)/Maintenance overtime, badges and retesting.)				

Submitted by (Signature): \_\_\_\_\_  
 Name (Printed or Typed): \_\_\_\_\_  
 Title: \_\_\_\_\_  
 Date: \_\_\_\_\_





**SECTION CB**

**SUPPLEMENTARY CONDITIONS TO THE  
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION AS AMENDED**

Add the following Subparagraph:

**1.1.11 DESCRIPTION OF PARTIES**

The following definitions apply to parties named in the Contract Documents.

1. Owner: Cypress-Fairbanks Independent School District  
Facilities & Construction Department  
11430-B Perry Road  
Houston, Texas 77064  
Phone: (281) 897-4057  
Representative: Jesse Clayburn, Asst. Superintendent of Facilities & Construction
2. Architect: PBK Architects, Inc.  
11 Greenway Plaza, 22<sup>nd</sup> Floor  
Houston, Texas 77046  
Phone: 713-965-0608
3. MEP Engineer: LEAF  
11 Greenway Plaza, 15<sup>th</sup> Floor  
Houston, Texas 77046  
Phone: (713) 965-0608
4. Civil Engineer: Brooks and Sparks  
21020 Park Row Dr.  
Katy, TX 77449  
Phone: (281) 578-9595
5. Roofing Consultants: BEAM  
11 Greenway Plaza, 15<sup>th</sup> Floor  
Houston, Texas 77046  
Phone: (713) 965-0608
6. Acoustic Engineer: BAI  
4726 Rainbow Run  
Sugarland, Texas 77479  
Phone: (281) 813-8518
7. Theatrical Engineer: WJHW  
12175 Network Boulevard Suite 150  
San Antonio, TX 78249  
Phone: (972)-934-3700

8. Structural Engineers:  
Kubala Engineers  
11 Greenway Plaza, 15<sup>th</sup> Floor  
Houston, Texas 77046  
Phone: (713-965-0608)

\*Include additional consultants as needed\*

**2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER**

Add the following Subparagraph:

- 2.2.6** The Contractor will be furnished, free of charge, **five (5)** sets of drawings, specifications, and addenda, for pickup by the Contractor from the office of the Architect.

**15.1 PREVAILING WAGE RATES**

- 15.1.3** Prevailing Wage Rate Determination Information follows on the *next page*.

**15.1 PREVAILING WAGE RATES**

## Prevailing Wage Rate Determination Information

*The following information is from Chapter 2258 Texas Government Code:*

### **Sec. 2258.021. Right to be Paid Prevailing Wage Rates.**

- (a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
  - (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
  - (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
- (b) Subsection (a) does not apply to maintenance work.
- (c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

### **Sec. 2258.023. Prevailing Wage Rates to be paid by Contractor and Subcontractor; Penalty.**

- (a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section [2258.022](#) to a worker employed by it in the execution of the contract.
- (b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
- (c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section [2258.022](#).
- (d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
- (e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

### **Sec. 2258.051. Duty of Public Body to Hear Complaints and Withhold Payment.**

A public body awarding a contract, and an agent or officer of the public body, shall:

- (1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
- (2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

## Prevailing Wage Rates – School Construction Trades

June 1, 2022

Texas Gulf Coast Area

CLASSIFICATION	2022 HOURLY RATE
ASBESTOS WORKER	\$21.13
BRICKLAYER; MASON	\$25.32
CARPENTER; CASEWORKER	\$23.38
CARPET LAYER; FLOOR INSTALLER	\$25.12
CONCRETE FINISHER	\$23.40
DATA COMM/TELE COMM	\$23.50
DRYWALL INSTALLER; CEILING INSTALLER	\$26.65
ELECTRICIAN	\$25.93
ELEVATOR MECHANIC	\$28.80
FIREPROOFING INSTALLER	\$22.25
GLAZIER	\$22.30
HEAVY EQUIPMENT OPERATOR	\$22.40
INSULATOR	\$20.50
IRONWORKER	\$25.50
LABORER, HELPER	\$16.71
LATHERER; PLASTERER	\$23.25
LIGHT EQUIPMENT OPERATOR	\$20.50
METAL BUILDING ASSEMBLER	\$21.10
MILLWRIGHT	\$33.63
PAINTER; WALL COVERING INSTALLER	\$19.60
PIPEFITTER	\$26.97
PLUMBER	\$26.71
ROOFER	\$20.50
SHEET METAL WORKER	\$19.90
SPRINKLER FITTER	\$26.13
STEEL ERECTOR	\$23.25
TERRAZZO WORKER	\$23.50
TILE SETTER	\$19.58
WATERPROOFER; CAULKER	\$19.88

**Prevailing Wage Rates**  
**Worker Classification Definition Sheet**

CLASSIFICATION	DEFINITION
ASBESTOS WORKER	Worker who removes and disposes of asbestos materials.
BRICKLAYER; MASON	Craftsman who works with masonry products, stone, brick, block, or any material substituting those materials and accessories.
CARPENTER; CASEWORKER	Worker who builds wood structures or structures of any material which has replaces wood. Includes rough and finish carpentry, hardware, and trim.
CARPET LAYER; FLOOR INSTALLER	Worker who installs carpets and /or floor coverings, vinyl tile.
CONCRETE FINISHER	Worker who floats, trowels, and finishes concrete.
DATA COMM/TELE COMM	Worker who installs data/telephone and television cable and associate equipment and accessories.
DRYWALL; CEILING INSTALLER	Worker who installs metal framed walls and ceiling, drywall coverings, ceiling grids, and ceilings.
ELECTRICIAN	Skilled craftsman who installs or repairs electrical wiring and devices. Includes fire alarm systems and HVAC electrical controls.
ELEVATOR MECHANIC	Craftsman skilled in the installation and maintenance of elevators.
FIREPROOFING INSTALLER	Worker who sprays or applies fire proofing materials.
GLAZIER	Worker who installs glass, glazing, and glass framing.
HEAVY EQUIPMENT OPERATOR	Includes but not limited to all CAT tractors, all derrick-powered, all power operated cranes, back-hoes, back-fillers, power operated shovels, winch trucks, and all trenching machines.
INSULATOR	Worker who applies, sprays, or installs insulation.
IRONWORKER	Skilled craftsman who erects structural steel framing and installs structural concrete Rebar.
LABORER, HELPER	Worker qualified for only unskilled or semi-skilled work. Lifting, carrying materials or tools, hauling, digging, clean up.
LATHERER; PLASTERER	Worker who installs metal framing and lath. Worker who applies plaster to lathing and installs associated accessories.
LIGHT EQUIPMENT OPERATOR	Includes but not limited to, air compressors, truck crane drivers, flex planes, building elevators, form graders, concrete mixers less than 14cf), conveyers.
METAL BUILDING ASSEMBLER	Worker who assembles pre-made metal buildings.
MILLWRIGHT	Mechanic specializing in the installation of heavy machinery, conveyance, wrenches, dock levelers, hydraulic lifts, and align pumps.
PAINTER; WALL COVERING INSTALLER	Worker who prepares wall surfaces and applies paint and/or wall coverings, tape, and bedding.
PIPEFITTER	Trained worker who installs piping systems, chilled water piping and hot water (boiler) piping, pneumatic tubing controls, chillers, boilers, and associated mechanical equipment.
PLUMBER	Skilled craftsman who installs domestic hot and cold water piping, waste piping, storm system piping, water closets, sinks, urinals, and related work.
ROOFER	Worker who installs roofing materials, Bitumen (asphalt and coal tar) felts, flashings, all types of roofing membranes, and associated products.
SHEET METAL WORKER	Worker who installs sheet metal products, Roof metal, flashings and curbs, ductwork, mechanical equipment, and associated metals.
SPRINKLER FITTER	Worker who installs fire sprinklers systems and fire protectant equipment.
STEEL ERECTOR	Worker who erects and dismantles structural steel frames of buildings and other structures.
TERRAZZO WORKER	Craftsman who places and finishes Terrazzo
TILE SETTER	Worker who prepares wall and/or floor surfaces and applies ceramic tiles to these surfaces.
WATERPROOFER; CAULKER	Worker who applies water proofing material to buildings. Products include sealant, caulk, sheet membranes, and liquid membranes, sprayed, rolled, or brushed.

END OF DOCUMENT

## **Section CC**

### **Right of Audit - Examination of Records**

1. Records for all contracts, specifically including but not limited to lump sum contracts (i.e. fixed price or stipulated sum contracts), unit price, cost plus or time & material contracts with or without a guaranteed maximum (or not-to-exceed amounts) shall upon reasonable notice be open to inspection and subject to audit, scanning, and/or reproduction during normal business working hours. Such audits may be performed by any Owner's representative, or any outside representative engaged by Owner for the purpose of examining such records. The Owner or its designee may conduct such audits or inspections throughout the term of this contract and for a period of three years after final payment or longer if required by law. Owner's representatives may (without limitation) conduct verifications such as counting employees at the Construction Site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, subcontractors, and vendors.
2. Contractor's "records" as referred to in this Exhibit shall include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in Owner's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records shall include (hard copy, as well as computer readable data if it can be made available), written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; change order files (including documentation covering negotiated settlements); backcharge logs and supporting documentation; invoices and related payment documentation; general ledger, information detailing cash and trade discounts earned, insurance rebates and dividends; and any other contractor records which may have a bearing on matters of interest to the Owner in connection with the contractor's dealings with the Owner (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of any or all of the following:
  - a) Compliance with contract requirements for deliverables
  - b) Compliance with approved plans and specifications
  - c) Compliance with Owner's business ethics expectations
  - d) Compliance with contract provisions regarding the pricing of change orders
  - e) Accuracy of contractor representations regarding the pricing of invoices
  - f) Accuracy of contractor representations related to claims submitted by the contractor or any of his payees.
3. Contractor shall require all payees (examples of payees include subcontractors, material suppliers, insurance carriers, etc.) to comply with the provisions of this article by including the requirements hereof in a written contract agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum contracts) have the same right to audit provisions contained in this contract.
4. Owner's authorized representative(s) shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this contract and shall be provided adequate and appropriate workspace, in order to conduct audits in compliance with this article.
5. If an audit inspection or examination in accordance with this article, discloses overpricing or overcharges to the Owner (of any nature) by the Contractor and/or the Contractor's Subcontractors in excess of \$100,000 in addition to making adjustments for the overcharges, the reasonable actual cost of the Owner's audit shall be reimbursed to the Owner by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of Owner's findings to Contractor.



## Section CC

### Right of Audit – Records to Be Provided to Owner’s Representatives Upon Request

In addition, to the normal paperwork documentation the Contractor typically furnishes to the Owner, in order to facilitate efficient use of Owner resources when reviewing and/or auditing the Contractor’s billings and related reimbursable cost records, the Contractor agrees to furnish (upon request) the following types of information in the specified computer (PC) readable file format(s):

Type of Record	PC Readable File Format
Monthly Job Cost Detail	.pdf and Excel
Detailed job Cost History To Date	.pdf and Excel
Monthly Labor Distribution detail (if not already separately detailed in the Job Cost Detail)	.pdf and Excel
Total Job to date Labor Distrubution detail (if not already included in the detailed Job Cost History to date)	.pdf and Excel
Employee Timesheets documenting time worked by all individuals who charge reimbursable time to the project	.pdf
Daily Foreman Reports listing names and hours and tasks of personnel who worked on the project	.pdf
Daily Superintendent Reports	.pdf
Detailed Subcontract Status Reports (showing original subcontract value, approved subcontract change orders, subcontractor invoices, payment to subcontractors, etc.	.pdf and Excel
Copies of Executed Subcontracts with all Subcontractors	.pdf
Copies of all executed change orders issued to Subcontractors	.pdf
Copies of all documentation supporting all reimbursable job costs (subcontractor payment applications, vendor invoices, internal cost charges, etc.)	.pdf

# DRAFT AIA® Document A101™ – 2017

## Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

**AGREEMENT** made as of the [DAY]TH day of [MONTH] in the year 2025  
(In words, indicate day, month and year.)

**BETWEEN** the Owner:  
(Name, legal status, address and other information)

Cypress-Fairbanks Independent School District  
11430-B Perry Road  
Houston, Texas 77064  
Telephone: 281-897-4057  
Fax: 281-897-3806

and the Contractor:  
(Name, legal status, address and other information)

« (TBD) »  
« »  
« Telephone: »

for the following Project:  
(Name, location and detailed description)

**PROJECT NAME**  
CFISD Project Number: XX-XX-XXXXR-RFP  
Architect Project No. XXXX

**ADDRESS**

The Architect:  
(Name, legal status, address and other information)

**ARCHITECT INFO**

The Owner and Contractor agree as follows.

**ADDITIONS AND DELETIONS:**  
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.



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## TABLE OF ARTICLES

1	THE CONTRACT DOCUMENTS
2	THE WORK OF THIS CONTRACT
3	DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4	CONTRACT SUM
5	PAYMENTS
6	DISPUTE RESOLUTION
7	TERMINATION OR SUSPENSION
8	MISCELLANEOUS PROVISIONS
9	ENUMERATION OF CONTRACT DOCUMENTS
10	INSURANCE AND BONDS

### ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), all sections of the Project Manual and Construction Documents, Drawings, Specifications, Addenda issued prior to execution of this Agreement, the Contractor's proposal and written amendments or addenda to the proposal, the Contractor's bonds and proof of insurance, other documents listed in this Agreement, Modifications issued after execution of this Agreement, and attached exhibits; these form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

"Construction Documents" means: all drawings, specifications, submittals, transmittals, deliverables, instructions to Contractors, and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants and which set forth in detail the requirements for construction of the Project.

### ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

### ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

#### § 3.1

The date of commencement of the Work shall be:  
(Check one of the following boxes.)

- [ « » ] The date of this Agreement.
- [ « X » ] A date set forth in a notice to proceed issued by the Owner. The Contractor may not commence construction, however, until all bonds and insurance required by the Contract Documents have been received by the Owner. All bonds and insurance will be reviewed and approved by the Owner for compliance with the Contract Documents prior to the Contractor mobilizing onsite. Upon Owner approval, the Contractor will be allowed to mobilize onsite.
- [ « » ] Established as follows:  
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than the date(s) listed below:

*(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)*

Portion of Work	Substantial Completion Date
Entire Scope of Work	[REFER TO SUMMARY OF WORK]

subject to adjustments of the Contract Time as provided in the Contract Documents.

*(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)*

Contractor shall achieve buy out of all subcontracts and trades within thirty (30) days following Notice to Proceed.

Contractor shall provide complete Schedule of Values within thirty (30) days following Notice to Proceed.

Liquidated Damages: Refer to AIA Document A201™–2017, General Conditions of the Contract for Construction as amended, Article 8.4.

**ARTICLE 4 CONTRACT SUM**

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor’s performance of the Contract. The Contract Sum shall be XXXX Dollars (\$00.00), subject to additions and deductions as provided in the Contract Documents.

§ 4.1.1 The Contract Sum contains an Owner’s Betterment Allowance in the amount of XXXX Dollars (\$0.00). This allowance is for the sole use of the Owner to be used for changes in the scope of the Work and for the betterment of the Project. Owner’s authorized representative may approve any expenditure from Owner’s Betterment Allowance without further Board of Trustees approval. If the Owner’s Betterment Allowance is not expended or not fully expended, then any unused portion shall belong to the Owner and shall be credited to the Owner in calculating final payment.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:  
*(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)*

Base Proposal in the amount of .....	\$0.00
Total Contract Sum.....	\$0.00
Refer to Exhibit A (includes Base Proposal, Alternate Proposal(s) and Unit Price(s).)	

§ 4.3 Unit prices, if any:  
*(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)*

Item	Units and Limitations	Price per Unit (\$0.00)

Refer to Exhibit A, Form AC – Competitive Sealed Proposal Form, Base Proposal and Alternate Proposal

§ 4.4 Allowances included in the Contract Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Allowance Amount
Owner's Betterment Allowance	[REFER TO ALLOWANCE]

## ARTICLE 5 PAYMENTS

### § 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be at equal one-month intervals. No more than one (1) Application for Payment may be submitted within a given calendar month and shall be submitted to the Owner as required in AIA Document A201™-2017, as amended Article 9.3.6.

§ 5.1.3 The Owner shall make payment of the undisputed, certified amount to the Contractor not later than thirty (30) days after Owner received the Application for Payment, that has been certified by the Architect. If errors are discovered by the Owner in the certified Application for Payment, the Owner shall reject the Application for Payment and return it to the Contractor for correction. The specified time period for payment of such Application for Payment will start over on the date the Owner receives the corrected Application for Payment that has been re-certified by the Architect.

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule, unless objected to by the Architect and Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of five percent (5.0%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.8 of AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended;
- .2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of five percent (5.0%);
- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201™-2017, as amended.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201™-2017, as amended.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:

*(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)*

«The full applicable five percent (5.0%) retainage will be held until Final Completion of the Work associated with the Contract has been achieved. »

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

## § 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when:

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2 of AIA Document A201–2017, as amended, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.
- .3 all project close-out documents in their entirety have been completed, submitted to and approved by the Owner.

§ 5.2.2 Upon verification and approval by the Architect and Owner that all Contract requirements have been completed in their entirety, the Contractor shall submit the final Application for Payment to the Architect for approval and certification. Upon receipt of such final Certificate for Payment, the Owner's final payment to the Contractor shall be made no later than thirty (30) days after the issuance of the Architect's final Certificate for Payment, or as follows:

If the Contractor submits the Final Application for Payment to the Architect prior to the verification and approval by the Architect and Owner that the Contractor has completed all Contract requirements, the Architect will return the Application for Final Payment to the Contractor as NOT APPROVED. If errors are discovered by the Owner in the certified Final Application for Payment, the Owner shall reject the Final Application for Payment and return it to the Contractor for correction. The specified time period for payment of such final Application for Payment will start over on the date the Owner receives the corrected final Application for Payment that has been certified by the Architect. Refer to AIA Document A201™–2017, Article 9 as amended.

§ 5.2.3 At the end of the project, after all work is completed according to the Contract Documents, including all closeout documents, the Owner shall release all retainage to the subcontractors, sub-subcontractors and vendors. The retainage for the General Contractor, including, but not limited to, all work self-performed by the General Contractor; and all general condition line items, shall be held until all lien releases have been provided to and accepted by the Owner.

The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment.

## § 5.3 Interest

Payments due and unpaid under the Contract for undisputed amounts shall bear interest pursuant to Texas Prompt Payment Act.

## ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Refer to AIA Document A201–2017, Article 4 as amended. For any Claim or dispute not resolved by the process in Article 4 of AIA Document A201-2017, as amended, the method of binding dispute resolution shall be litigation in a court of competent jurisdiction.

## ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017, as amended.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017, as amended.

## ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017, as amended or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Agreement shall be governed by the laws of the State of Texas, and any litigation shall be conducted in state district court. Mandatory and exclusive venue shall be in Harris County, Texas.

§ 8.3 As a material consideration of the making of this Agreement, the modifications to this Agreement shall not be construed against the maker of said modifications.

§ 8.4 Notwithstanding anything to the contrary in this Agreement, or in any document forming a part hereof, there shall be no mandatory arbitration for any dispute arising hereunder.

§ 8.5 The Contractor may not assign its responsibilities, duties, obligations, and rights under this Agreement, without the express written consent of the Owner. This does not prevent Contractor from engaging subcontractors to perform various phases of the Project, but Contractor shall be fully responsible to Owner for the Work, actions, and omissions of all such subcontractors.

§ 8.6 This Agreement, in its entirety, shall be binding upon all the parties hereto, their respective successor, heirs, executors, administrators, or assigns.

§ 8.7 Execution of this Agreement shall constitute approval and acceptance of all terms, covenants, and conditions as modified and contained in the Contract Documents.

§ 8.8 This Agreement is subject to all applicable federal and state laws, rules, and regulations. Invalidity of any portion of this Agreement under the law of the State of Texas or of the United States shall not affect the validity of the remainder of this Agreement.

§ 8.9 Contractor stipulates that Owner is a political subdivision of the State of Texas, and, as such, enjoys immunities from suit and liability as provided by the constitution and laws of the State of Texas. By entering into this Agreement, Owner does not waive any of its immunities from suit and/or liability, except as otherwise specifically provided herein, and as specifically authorized by law.

§ 8.10 The Owner's representative:  
*(Name, address, email address, and other information)*

Matthew Morgan  
Chief Operations Officer/Associate Superintendent  
Facilities, Construction & Support Services  
Cypress-Fairbanks Independent School District  
11440 Matzke Road  
Cypress, Texas 77429  
Telephone: 281-517-2809  
Fax: 281-517-2114

Jesse Clayburn  
Assistant Superintendent of Facilities and Construction  
Cypress-Fairbanks Independent School District  
11440 Matzke Road  
Cypress, Texas 77429  
Telephone: 281-897-4057  
Fax: 281-897-3806

PROJECT MANAGER  
 Project Manager  
 Cypress-Fairbanks Independent School District  
 11430 Perry Road  
 Houston, Texas 77064  
 Telephone: 281-XXX-XXXX  
 Fax: 281-897-3806

§ 8.11 The Contractor's representative:  
 (Name, address, email address, and other information)

<< >>  
 << >>  
 << >>  
 << >>  
 << >>  
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§ 8.12 Neither the Owner's nor the Contractor's representative shall be changed without ten (10) days written notice to the other party.

§ 8.13 Other Provisions

§ 8.13.1 All terms "Bidders" and "Bids" are modified to "Proposers" and "Proposals".

§ 8.13.2 Contractor and each subcontractor and sub-subcontractor assigning hereby assigns to Owner any and all claims for overages associated with this Contract which arises under the Antitrust laws of the United States, 15 U.S.C.A. Section 1, et.seq (1973).

**ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS**

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2017, Standard Form of Agreement Between Owner and Contractor, as amended.

§ 9.1.2 The General Conditions are AIA Document A201–2017, General Conditions of the Contract for Construction as amended.

Document	Title	Date	Pages
Section CA Section CB	Application for Payment Checklist Supplementary Conditions to the General Conditions of the Contract for Construction as Amended		
Section CC	Right to Audit		

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
Exhibit A	Forms AC, AE, AF, AG, AH, AN and Resumes		
Exhibit B	Front End Documents Table of Contents		

§ 9.1.4 The Specifications:  
 (Either list the Specifications here or refer to an exhibit attached to this Agreement.)



« »

Section	Title	Date	Pages
Exhibit C	Specifications Table of Contents		

§ 9.1.5 The Drawings:  
*(Either list the Drawings here or refer to an exhibit attached to this Agreement.)*

« »

Section	Title	Date	Pages
Exhibit D	Index of Drawings		

§ 9.1.6 The Addenda, if any:

Number	Date	Pages
Addendum No. 1		

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

Other documents, if any, listed below:

*(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2017, as amended provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor’s bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)*

Section	Title	Date	Pages
Exhibit E	Section 01 35 23 Special Owner Requirements		
Exhibit F	Post Proposal Addendum No. X (If Applicable)		

**ARTICLE 10 INSURANCE AND BONDS**

§ 10.1 The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2017, as amended and Section BD of the project specifications.

This Agreement entered into as of the day and year first written above.

**OWNER** *(Signature)*

«Scott Henry, President of the Board of Trustees or  
 Administrative Designee  
 «Administrative Designee:  
 Mr. Matthew Morgan,  
 Chief Operations Officer/Associate Superintendent  
 of Facilities, Construction & Support Services »

*(Printed name and title)*

**CONTRACTOR** *(Signature)*

« »  
 « »  
 « »  
 « »  
 « »  
 « »

*(Printed name and title)*

# DRAFT AIA® Document A201® - 2017

## General Conditions of the Contract for Construction

### for the following PROJECT:

(Name and location or address)

2022 Arnold MS Renovation  
CFISD Project Number: 21-10-5708R-RFP  
Architect Project No. 220023

### CAMPUS ADDRESS:

11111 Telge Rd., Cypress 77429 2

### THE OWNER:

(Name, legal status and address)

Cypress-Fairbanks Independent School District  
11430-B Perry Road  
Houston, Texas 77064  
Telephone Number: (281) 897-4108  
Fax Number: (281) 897-3806»

### THE ARCHITECT:

(Name, legal status and address)

PBK Architects  
11 Greenway Plaza, 22nd Floor  
Houston, TX 77046  
713-965-0608

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- 8 TIME
- 9 PAYMENTS AND COMPLETION
- 10 PROTECTION OF PERSONS AND PROPERTY
- 11 INSURANCE AND BONDS

### ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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## **ARTICLE 1 GENERAL PROVISIONS**

### **§ 1.1 Basic Definitions**

#### **§ 1.1.1 The Contract Documents**

The Contract Documents are enumerated in the Agreement between the Owner and Contractor as amended (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract, as amended (General, Supplementary and other Conditions), Performance Bond, Labor and Materials Payment Bond and Proof of Insurance, Contractor's Proposal, Drawings, Specifications, all Addenda issued prior to execution of the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or a Change Proposal Request, or (4) a written order for a minor change in the Work issued by the Architect.

#### **§ 1.1.2 The Contract**

The Contract Documents form the Contract for Construction. This agreement, as amended, represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Construction Documents become part of the Contract when accepted by the Owner. All sections of the Project Manual shall be a part of the Contract, including any Proposal signed by the Contractor, and any Request for Proposals for the Project ("RFP"). The Contract may be amended or modified only by a written Modification signed by the Owner. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

#### **§ 1.1.3 The Work**

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

It also includes all supplies, skill, supervision, transportation services, storage requirements and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

#### **§ 1.1.4 The Project**

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

#### **§ 1.1.5 The Drawings**

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

#### **§ 1.1.6 The Specifications**

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### **§ 1.1.7 The Project Manual**

The Project Manual is a volume assembled for the Work which may include the bidding or proposal requirements, sample forms, Conditions of the Contract and Specifications.

#### **§ 1.1.8 Addenda**

Addenda are written or graphic instruments issued prior to the execution of the Contract which modify or interpret the Proposal Documents, including Drawings and Specifications, by additions, deletions, clarifications or corrections. Addenda will become part of the Contract Documents when the Construction agreement is executed. The successful Contractor and his Subcontractors shall post all addendum items on their sets of Drawings and Specifications.

#### **§ 1.1.9 Approved Equal, Approved Equivalent or Equal**

The terms Approved and Approved Equivalent relate to the substitution of products or systems approved in writing by the Architect. Refer to Paragraph 3.19 Substitution of Products and Systems for procedure which must be followed.

#### **§ 1.1.10 Proposal Documents**

Proposal Documents consist of all documents bound into or referenced in the Project Manual, the Drawings, and Addenda related thereto. The Project Manual contains the Proposal Requirements, Sample Forms, Conditions of the Contract, the Specifications, and a list of Drawings, and Schedules, some of which are bound into the Project Manual (Other Drawings and Schedules are bound separately).

#### **§ 1.1.11 Miscellaneous Other Words**

The terms "Bids" or "Bidding" mean Competitive Sealed Proposal, which by definition allows the Owner to accept the "best value" for the school district, based on factors other than cost.

### **§ 1.2 Correlation and Intent of the Contract Documents**

**§ 1.2.1** The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

**§ 1.2.2** Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

**§ 1.2.3** Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

#### **§ 1.2.4 Precedence of the Contract Documents**

The most recent issued Document takes precedence over the previous issued forms of the same Document. The order of precedence is as follows with the highest authority listed first.

- .1 The Agreement
- .2 The Addenda
- .3 Conditions of the Contract, Drawings and Specifications shall have equal authority. Should these documents disagree in themselves, the Architect will select the appropriate method for performing the work at no additional increase in the Contract Cost.

In the case of an inconsistency between the Drawings and Specifications or within either set of Documents discovered prior to Proposal Time but too late to be clarified by an Addendum, the better quality or greater quantity of work shall be included in the proposal. Clarification of the inconsistency will be accomplished with Contractor after award of the Contract, and if necessary, an appropriate reduction in the Contract will be accomplished by Change Order.

#### **§ 1.2.5 Relation of Specifications and Drawings**

The Drawings and Specifications are correlative and have equal authority and priority. Should they disagree in themselves, or with each other, base the proposals on the most expensive combination of quality or quantity of work indicated. The appropriate method of performing the Work, in the event of the above-mentioned disagreements, will be made by the Architect.

#### **§ 1.2.6 Optional Materials, Brands and Processes**

When more than one is specified for a particular item of Work, the choice shall be the Contractor's. The final selection of color and pattern will be made by the Architect from the range available within the option selected by the Contractor, unless the item is specified to match a specific color or sample furnished. Where particular items are specified only products of those named manufacturers are acceptable. Certain specified construction and equipment details may not be regularly included as part of the named manufacturer's standard catalog equipment but shall be provided by the manufacturer as required for the proper functioning of the equipment. Reasonable minor variations in equipment are expected and will be acceptable; however, indicated and specified performance and material

requirements are minimum, and will be required in addition to standard accessories. The Architect reserves the right to determine the equality of equipment and materials that deviate from any of the indicated and specified requirements.

### **§ 1.2.7 Standards and Requirements**

When the Contract Documents refer to standards, building codes, manufacturers' instructions, or other documents, unless otherwise specified, then the current edition as of the date of execution of the Agreement by the last party to execute said Agreement shall apply. It shall be the responsibility of the Architect to address revisions or amendments to applicable codes or standards which arise after the date of execution of the Agreement and until Final Completion, pursuant to the terms of the Agreement between Owner and Architect. Requirements of public authorities apply as minimum requirements only and do not supersede more stringent specified requirements.

### **§ 1.3 Capitalization**

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### **§ 1.4 Interpretation**

In the interest of brevity, the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

### **§ 1.5 Execution of Contract Documents**

**§ 1.5.1** The Contract Documents shall be signed by the Owner and Contractor. If either the Owner or Contractor or both do not sign all the Contract Documents, the Architect shall identify such unsigned Documents upon request.

**§ 1.5.2** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements to the Contract Documents. If an approved Contract Document requiring Contractor's signature has not been signed, then the missing signature shall be provided within a reasonable period of time. Failure of Contractor to sign an approved Contract Document after notice and a reasonable opportunity to sign, shall be considered a material breach of the Contract by Contractor.

### **§ 1.6 Ownership and Use of Drawings, Specifications and Other Instruments of Service**

**§ 1.6.1** The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants are Construction Documents through which the Work to be executed by the Contractor is described. All ownership rights, whether common law, statutory, or other reserved rights, including copyright ownership of the Construction Documents, are controlled by the Agreement between the Owner and Architect. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect or the Architect's consultants. The Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of any copyrights or other reserved rights.

### **§ 1.7 Miscellaneous Other Definitions**

#### **§ 1.7.1 Alternate Proposal(s)**

A separate amount stated on the Proposal Form which, if accepted by the Owner, will be added to or deducted from the Base Proposal. If accepted, the work that corresponds to the alternate proposal will become part of the Agreement between Owner and Contractor. Alternate proposals shall remain valid for a period of 120 days after receipt of proposals, unless otherwise modified, regardless if an Owner Contractor Agreement has been executed, unless

indicated otherwise herein.

### § 1.7.2 Base Proposal

The Contractor's proposal for the Work, not including any Alternates.

### § 1.7.3 Contract Time

The period of time which is established in the Contract Documents for Substantial Completion of the Work. This period of time is not subject to adjustment or extension without the written permission of the Owner.

### § 1.7.4 Date of Agreement

The date the Owner formally awards a Contract for Construction of the Work. This date will be inserted on the first page of the Agreement Between Owner and Contractor and shall be referenced in Performance Bond and Payment Bond forms. See also Date of Commencement of the Work.

### § 1.7.5 Date of Commencement of the Work

The commencement date shall be the date the contract award is approved by the CFISD Board of Trustees. This date constitutes day zero ("0") of Contract Time.

### § 1.7.6 Date of Final Completion

The end of construction. Refer to Section 9.10.

### § 1.7.7 Day

The following days are referenced in the documents:

- .1 Calendar Days: The days of the Gregorian Calendar. The Contract Time is established in Calendar Days and extensions of time granted for Regular Work Days lost, in excess of anticipated delay day allowance, will be converted to Calendar Days.
- .2 Holidays: The days officially recognized by the construction industry and/or Owner approved holidays, in this area as a holiday; normally limited to the observance days of New Year's Day, Martin Luther King, Jr. Day, Good Friday, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the Friday after, Christmas Eve, Christmas Day and New Year's Eve day.
- .3 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested, after expenditure of the Anticipated Delay Day Allowance, on the basis of Regular Work Days, and those days, if approved; will be converted to calendar days by multiplying by a factor of one and four-tenths (1.4). The Contractor is advised to refer to Section 01 35 23.1, Special Owner Requirements regarding after hours use of the premises.
- .4 Anticipated Delay Days Allowance: An allowance of Fifteen (15) Regular Work Days per year (or two (2) regular work days per month, whichever is less) is established as probable days lost due to delays beyond the Contractor's control. This allowance includes District testing dates and any other days the district directs the contractor to not perform work due to unspecified campus events. This additional Delay day allowance does not include anticipated weather days as indicated in section 8.3., also does not include Holidays as indicated in Section 1.7.7.2. These days for weather and holidays are to be added to this additional delay day allowance and are to be calculated in accordance with their respective section as indicated elsewhere in these general conditions to establish the grand total of the anticipated delay day allowance.
- .5 Evaluation of Delay Days: The Architect and Owner will evaluate delays claimed by the Contractor based on the Critical Path of the Contractor's construction schedule, and if the Architect is in agreement that a Critical Path task has been delayed due to circumstances beyond the Contractor's control, the accepted delay days will be deducted from the Anticipated Delay Day Allowance.
- .6 Delay Days: Regular Work Days when circumstances beyond the Contractor's control prevent progress on major portions of the Work as described in Paragraph 8.3, Delays and Extensions of Time, in the General Conditions of the Contract for Construction.

### § 1.7.8 Notice to Proceed

A notice that may be given on behalf of the Owner to the Contractor, through the Architect, that directs the Contractor to start the Work. It also establishes the Date of Commencement of the Work.

### § 1.7.9 Provide

Whenever the word "provide" is used in these documents, it shall mean the same as "furnish and install."

### § 1.7.10 Punch List

A comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be completed or corrected; this list may be supplemented by the Architect or Owner. Refer to Article 9.8.

## ARTICLE 2 OWNER

### § 2.1 General

§ 2.1.1 The Owner is the independent school district identified in the Contract Documents. The Board of Trustees, by majority vote, is the only representative of the Owner, an independent school district, having the power to: enter into a contract; amend a contract; approve changes in the scope of the Work; approve and execute a Change Order or Construction Change Directive modifying the Contract Sum; agree to an extension to the date of Substantial or Final Completion; or terminate a contract. The Board designates authorized representatives to act on its behalf for day-to-day operations under the Contract. Unless otherwise designated in the Contract Documents, Owner's authorized representative shall be the Superintendent of Schools, who may delegate responsibilities as appropriate. Owner's Board of Trustees hereby delegates to the Superintendent of Schools or designee the authority to approve changes to the Work where such changes are within the Owner's Betterment Allowance or other designated Allowances stipulated in the Contract Documents and also the authority to approve any Change Order which does not exceed \$249,999.99 and the authority to approve any and all time extensions to the Contract. Any Change Order that is valued at or above \$250,000 shall require Board approval in accordance with Local Board Policy. Except as otherwise provided in the Contract Documents, the Architect does not have such authority. Neither Architect nor Contractor may rely upon the direction of any employee of Owner who has not been designated in writing in the Contract Documents. Owner shall not be financially responsible for actions taken by the Architect or Contractor in reliance upon direction from unauthorized persons.

§ 2.1.2 It shall be distinctly understood that by virtue of this Contract, neither the Contractor nor any contractor, subcontractor, sub-subcontractor, consultant, design professional, mechanic, material person, artisan, or laborer, skilled or unskilled, shall ever in any manner have, claim, or acquire any lien upon the buildings or any of the improvements of whatsoever nature or kind so erected or to be erected by virtue of this Contract or upon any of the land on which said buildings or any of the improvements are so erected, built, or situated. It shall be further understood that this Contract is not written for the benefit of third parties nor shall it be construed to create any third party beneficiaries.

### § 2.2 Information and Services Required of the Owner

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to reasonably rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work, shall exercise due diligence in attempting to located underground utilities, and shall notify the Owner and Architect of any discrepancies between the surveys and actual conditions of the site that Contractor observes or should observe in the exercise of ordinary care.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control



and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Refer to Section CB, Supplementary Conditions, for quantities of plans and project specifications to be furnished to the Contractor.

### § 2.3 Owner's Right to Stop the Work

§ 2.3.1 If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

### § 2.4 Owner's Right to Carry Out the Work

§ 2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven (7) Calendar Days after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, immediately correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

### § 2.5 Owner's Right to Occupy the Project

§ 2.5.1 The Owner shall have the right to occupy or use without prejudice to the right of either party, any completed or largely completed portions of the project, notwithstanding the time for completing the entire work or such portions may not have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents and Contractor shall be responsible for insurance, utilities and security until Substantial Completion of the entire project.

§ 2.5.2 Refer to Article 11 - Insurance and Bonds regarding property insurance requirements in the event of such occupancy.

## ARTICLE 3 CONTRACTOR

### § 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents in a good and workmanlike manner and in an expeditious and economical manner consistent with the interest of the Owner; shall exercise the degree of care, skill, and diligence in the performance of the Work in accordance with and consistent with industry standards for similar projects; shall utilize its best skill, effort, and judgment in diligently performing the Work; and shall furnish efficient business administration and supervision. Workmanship shall be of a quality to produce satisfactory results.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

### § 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 The Contractor shall carefully study and compare the Agreement, Conditions of the Contract, Drawings, Specifications, Addenda, Modifications, and information provided by the Owner and shall at once report to the

Architect any error, inconsistency, or omission he may discover. Contractor shall be liable for any damage to Owner for failure to report any error, inconsistency or omission he may discover or should have discovered, but he shall not be liable to Owner or Architect for any damage resulting for such error, inconsistency or omission which he did discover and at once so reported. Contractor shall not perform any work without approved Drawings and Specifications issued by the Architect.

§ 3.2.2 Any design errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect, but it is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents. The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations, but any nonconformity discovered by or made known to the Contractor shall be reported promptly to the Architect.

§ 3.2.3 If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect in response to the Contractor's notices or requests for information pursuant to Sections 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Sections 4.3.6 and 4.3.7. If the Contractor fails to perform the obligations of Sections 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect.

§ 3.2.4 The Contractor shall take field measurements and verify field conditions and shall carefully compare such fields measurements and conditions and other information known to the Contractor with the Contract documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Architect at once.

§ 3.2.5 The Contractor shall not be entitled to additional compensation for the "rework portion" of any additional work caused by his failure to carefully study and compare the contract documents prior to execution of the Work.

§ 3.2.6 The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work complies with the Contract Documents. The Contractor shall arrange meetings prior to commencement of the work of all major subcontractors to allow the subcontractor to demonstrate his understanding of the documents to the Architect/Owner and to allow the subcontractor to ask for any interpretation he may require.

§ 3.2.7 If, in the opinion of the architect, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his Consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to above requirements before additional services are performed.

§ 3.2.8 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, he shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes, including substitution of materials, shall be accomplished by appropriate Modification.

### § 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the

Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Contractor shall not be responsible for any resulting loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

**§ 3.3.2** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

**§ 3.3.3** The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

**§ 3.3.3.1** The Contractor is especially cautioned to coordinate the routing of all mechanical, plumbing and electrical items and provide coordinating drawings in accordance with provisions of the Contract Documents prior to commencing these operations.

**§ 3.3.4** Contractor shall document existing facility conditions and systems onsite prior to performing any work with video recording and/or photographs and shall test said systems to identify any pre-existing deficiencies in the presence of the Owner, Architect/Engineer. Any items not noted or identified in this documentation or brought the attention of the Owner in writing will be assumed to be in working order and any problems with such systems will be the responsibility of the Contractor to correct and repair to the pre-contract condition or better.

**§ 3.3.5** Prior to performing any work, the Contractor shall locate all utility lines as shown on the plans and specifications, including telephone company lines and cables, sewer lines, water pipes, gas lines, and electrical lines, and shall perform the Work in such a manner as to avoid damaging any such lines, cables, pipes and pipelines. In addition, the Contractor shall independently determine the location of same.

#### **§ 3.4 Labor and Materials**

**§ 3.4.1** Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, eligible to work in accordance with state and federal law. In addition, unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

**§ 3.4.2** Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with prior written consent of the Owner, after evaluation by the Architect and in accordance with a Change Order, Construction Change Directive, or Change Proposal Request.

**§ 3.4.3** The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

#### **§ 3.5 Warranty**

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. The Contractor is solely responsible for, and shall provide written proof of maintenance, service, and protection of materials and equipment installed prior to Substantial Completion.

§ 3.5.2 In the event of failure of materials, products, or workmanship, either during construction or the warranty period (as specified in Section 3.5.5), the Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Owner or Architect. Items of work first performed after Substantial Completion shall have their warranties extended by the period of time between Substantial Completion and the actual performance of the Work. Such warranties shall be submitted to owner in writing, documenting such time extensions. This warranty period shall not restrict or modify extended warranties called for or provided on systems, equipment or other specific portions of the work.

§ 3.5.3 Contractor shall establish a spreadsheet-type Warranty Work tracking format included in the Project Manual and shall verify and certify completion of each warranty work item.

§ 3.5.4 Approximately six (6) and eleven (11) months after Substantial Completion, the Contractor shall accompany the Owner and Architect on a complete re-inspection of the Project and be responsible for correcting any additional deficiencies observed or reported, including any uncompleted Punch List Items or outstanding or incomplete Warranty Items.

§ 3.5.5 The Warranty Period for this Project is One (1) Year from the date of Substantial Completion except for any extended warranties as specified herewith in the Contract Documents

§ 3.5.6 The warranty period shall extend one (1) year on specific items of work (materials and labor) if warranty work is performed on a specific item or work that requires the issuance of a second warranty work request within ninety (90) days after the original warranty work request was issued.

§ 3.5.7 Warranty work shall be performed within ten (10) working days after the Contractor receives a request for warranty work, except where immediate responses are required as described below:

- .1 For work which is identified as affecting life safety, fire alarm or security of the occupants and/or the facility on the warranty request, on-site corrective work shall begin immediately after receipt of the warranty work request by the Contractor, 365 days per year, twenty-four (24) hours per day.
- .2 For work affecting the operation of the HVAC system, domestic water heaters, elevators and food service equipment (except walk-in refrigeration and/or freezer equipment), on-site corrective work shall begin within six (6) hours of Contractor's receipt of warranty work, 365 days per year 24 hours per day.
- .3 For walk-in refrigeration and/or freezer equipment, on-site corrective work shall begin within four (4) hours of Contractor's receipt of warranty work, 365 days per year, 24 hours per day.

§ 3.5.8 For warranty work requiring immediate response as described in 3.5.7 above, the Contractor shall maintain or contract for an answering service available 365 days per year, 24 hours per day.

§ 3.5.9 Warranty work shall be completed within six (6) hours after the initiation of on-site corrective work unless additional time is reasonably required, and the Owner has agreed on the additional time frame deemed necessary by the Contractor.

§ 3.5.10 The Owner reserves the right to complete any warranty work that Contractor fails to complete in the specified time period. Owner will backcharge Contractor for the cost of such work, including Consultants' fees.

### § 3.6 Taxes

§ 3.6.1 The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and utilities and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects. The Contractor shall give a written statement to the Owner (with a copy to the Architect) as to the proration of costs of skilled crafts, labor and materials for the project prior to awarding of a Construction Contract. The Contractors shall obtain Certificates of Resale from their suppliers in order to avoid payment of the State Sales Tax on materials incorporated in School jobs. Failure of the Contractor to obtain Certificates of Resale from their suppliers shall make the Contractor responsible for absorbing the tax.

### § 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper

execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.1.1 The Owner will pay directly or to the governing authority directly from the Allowance, the cost of all permanent connection charges, including water and sewer tap charges and the provision and installation of the irrigation meter and the domestic water meter and vault. The Owner will pay directly to the governing authority the cost of all non-taxable entity fees, capacity charges, drainage impact fees and permanent utility account deposits.

§ 3.7.1.2 The Contractor shall pay directly all temporary utility connection charges, including utility district/company inspection, survey, and permit fees for both temporary and permanent connections.

§ 3.7.1.3 The Contractor shall include in the Base Proposal, the cost for providing all backflow preventers, fire sprinkler system backflow preventers, meters, vaults, valves, taps, and piping from taps for domestic water, irrigation, and fire sprinkler systems.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 It is neither the Contractor's responsibility nor the Owner's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations. However, if the Contractor observes or should have observed, that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Architect and Owner in writing, and necessary changes shall be accomplished by appropriate modification.

§ 3.7.4 If the Contractor performs Work which he knew or should have known it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect and Owner, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

### § 3.8 Allowances

§ 3.8.1 The General Contractor shall include in his proposal all allowances stated in the Specifications.

These stated allowances represent the cost estimate of the materials and equipment delivered and unloaded at the site. The Contractor's supervision, handling costs, estimating costs, miscellaneous fees, overhead, profit, clean-up, as-builts, warranty, and other expenses contemplated for the allowance material and equipment shall be included in allowances only where called for in the various sections of these specifications.

The Contractor shall purchase the allowance materials and equipment as directed by the Architect, upon approval by the Owner, on the basis of the lowest reasonable proposal of at least three (3) competitive proposals unless otherwise directed by Owner. If the actual cost of the materials and equipment delivered and unloaded at the site is more than all the allowance estimates, the Contract Sum will be adjusted by Change Order.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, miscellaneous fees, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner in sufficient time to avoid delay of the Work.

### **§ 3.9 Superintendent**

**§ 3.9.1** The General Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work including punch list work. The Superintendents and Project Manager shall be satisfactory to the Owner and Architect and shall not be changed except with the consent of the Owner and Architect, unless the Superintendent leaves the employment of the Contractor. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architects objects to any nominated superintendent or project manager. The superintendent and project manager shall represent the Contractor, and communications given to the superintendent and/or project manager shall be as binding as if given to the Contractor.

**§ 3.9.2** The Contractor shall furnish to the Owner and the Architect in writing the names and professional qualifications of the persons proposed by the Contractor as the project manager and superintendent with the submitted proposal. The Contractor shall not assign nor substitute any person as the project manager or superintendent to whom the Owner or the Architect has made reasonable objection. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architect objects to any nominated project manager and/or superintendent. The Contractor's submittal of the project manager and superintendent's professional qualifications with his proposal represent the Contractor's acknowledgement that the selection committee's evaluation of the Contractor's proposal includes said superintendent's qualifications and the understanding that said job superintendent will remain on site, full time, until the Architect and Owner have agreed that all punch list work has been completed. See also, Specification Section 01 35 23 – Special Owner Requirements, for additional job superintendent requirements. In addition, the Owner reserves the right to perform a criminal records history review of the proposed superintendent and other Contractor personnel prior to the Contract Award as may be deemed necessary.

**§ 3.9.3** Contractor will be required to keep the job superintendents on each job-site during the course of the construction until completion of all punch list items. In the event the job superintendents is absent from any job site at any time during the project contract time or during punch list completion and an agreed upon substitute is not provided, the Owner may backcharge the Contractor \$250.00 per occurrence.

**§ 3.9.4** The Contractor shall notify the Owner and Architect at the beginning of the work day if the superintendent is out sick. If the superintendent is to be out for any other reason, the Owner and Architect are to be notified at least 24 hours in advance. In both cases the Owner and Architect are to be informed of the name of the acting superintendent.

### **§ 3.10 Contractor's Construction Schedules**

**§ 3.10.1** The Contractor shall, within the time frame specified in Section 01 32 16, prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

**§ 3.10.2** The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

**§ 3.10.3** The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

**§ 3.10.4** The Contractor will provide a detailed critical path construction schedule including milestones for this project within the time frame specified in 01 32 16. This schedule shall be prepared using "Suretrak, Primavera, Microsoft Project" or other similar scheduling software. In addition, the Contractor shall submit to the Owner and Architect with each monthly Application for Payment a copy of the progress schedule showing all modifications required to have the schedule reflect appropriate revisions and shall take whatever action is necessary to assure that the project completion schedule is met. The Contractor is required to attend and to give a schedule update at each weekly construction administration meeting and shall provide a detailed 3 week work ahead schedule. The progress

schedule will include percentages of work completed to date along with percentages of work remaining to be completed. These percentages will be used in the verification of the Contractor's monthly Application for Payment. Pay Applications will not be processed by the Owner unless accompanied by an updated progress schedule. If the project is behind schedule, specific input will be required from the Contractor on how he intends to make up the time. If the project remains behind schedule for more than ten (10) working days, for any reason, the Owner, Architect, and Consultants and their associated personnel, shall be compensated by the Contractor, at their standard hourly billing rate, which will be provided as required, until such time as the Contractor can successfully demonstrate to all parties that the project is back on the agreed schedule. Contractor shall provide two (2) large format color prints one (1) for Owner and one (1) for jobsite of the construction schedule monthly with all items showing current status and original baseline schedule.

### **§ 3.11 Documents and Samples at the Site**

The Contractor shall maintain at the site for the Owner one (1) copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one (1) copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

### **§ 3.12 Shop Drawings, Product Data and Samples**

**§ 3.12.1** Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

**§ 3.12.2** Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**§ 3.12.3** Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

**§ 3.12.4** Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

**§ 3.12.5** The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

**§ 3.12.6** By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents, and (4) coordinated said shop drawings, product data, samples and submittals with adjacent work and its related submittals to be compatible and not in conflict for installation.

**§ 3.12.7** The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

**§ 3.12.8** The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific

deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof, except for any such errors or omissions which are within the Architect's statutory or contractual design responsibility.

**§ 3.12.9** The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

**§ 3.12.10** The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

**§ 3.12.11** If, in the opinion of the Architect, the Shop Drawings are incomplete, indicate an inadequate understanding of the work covered by the Shop Drawings, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the Shop Drawings will be returned, unchecked, to the Contractor for correction of any of the above deficiencies and subsequent resubmittal. Additional service charges may be charged to the Contractor by the Architect in this event.

**§ 3.12.12** The Contractor shall submit drawings, data and samples to the Architect at least fifteen (15) Regular Work Days prior to the date the Contractor needs the reviewed submittals returned. The Architect and his consultants will be allowed fifteen (15) Regular Work Days for checking from date of submission of shop drawings that are acceptable and do not require re-submission in the opinion of the Architect. Where colors are to be selected by the Architect, submit all product color samples in adequate time to allow the Architect to prepare a complete selection schedule. In general, all submittals requiring color selection shall be submitted to the Architect within eight (8) weeks [four (4) weeks for a summer remodel] of the Contractor's receipt of Notice to Proceed on the Project.

**§ 3.12.13** The Contractor shall submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two (2) additional sets for the Architect, two (2) additional set for the Owner; one (1) additional set for each of the Architect's consultants involved with the particular Section of Work; (1) additional set of all mechanical shop drawings for TAB and one (1) additional set to be added to each copy of the Owner's Operation and Maintenance manuals at substantial completion. If, in the opinion of the Architect, the Shop Drawings are incomplete; indicate an inadequate understanding of the work covered by the Shop Drawings; or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the Shop Drawings will be returned, unchecked, to the Contractor for correction of these deficiencies and subsequent resubmittal. Additional service charges as outlined in Article 3.2.7 may be charged to the Contractor by the Architect in this event.

**§ 3.12.13.1** Where shop drawings are involved, submit one (1) high quality reproducible transparency and one (1) opaque print of the shop drawing for the Architect plus one (1) additional opaque print for each of the Architect's consultants involved with the particular Section of Work and one (1) additional print for each copy of the Owner's Operation and Maintenance Manuals to be submitted at Substantial Completion. The reproducible transparency will be



marked by the Architect and/or his consultants and returned to the contractor for his use, distribution, correction or resubmittal, as required. After final review and correction of the submittal, the Contractor shall send one (1) corrected set to the Architect and one (1) to each of the Architect's consultants involved with the particular Section of Work. Contractor shall also retain one (1) set of all reviewed Mechanical submittals to be transmitted to the HVAC Test and Balance agency selected by Owner.

**§ 3.12.14** The Contractor shall deliver in one (1) submittal, all material samples requiring a color selection by the Architect, within eight (8) weeks [four (4) weeks for summer remodel] of the Contractor's receipt of a Notice to Proceed on the Project. The Architect will return material color selections within six (6) weeks [three (3) weeks for summer remodel] of receipt of the color samples from the Contractor.

**§ 3.12.15** The Contractor shall produce and submit for review, composite coordination drawings within four (4) weeks of the Contractor's receipt of a Notice to Proceed on the Project. The composite coordination drawings shall depict the coordination of all structural and architectural elements with HVAC piping, ductwork, mechanical equipment, electrical conduit, low voltage systems cabling, lighting, electrical switchgear and panels, security systems, domestic water piping, roof drains and storm sewer piping, sanitary sewer piping and fire sprinkler piping in a composite above ceiling plan and a composite mechanical and electrical equipment room floor plan. Plans shall be produced at a scale of one-quarter (1/4") per foot and shall include larger scale sections with vertical elevations of elements required to confirm coordination of all elements. A schedule value for the production of the composite coordination drawings shall be included in the Continuation Sheet of the Application and Certificate for Payment for each of the Divisions of trade. Refer to specification section 01 31 13 for detail coordination document requirements.

### **§ 3.13 Use of Site**

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

**§ 3.13.1** Contractor shall ensure that the Work, at all times, is performed in a manner that affords Owner reasonable access, both vehicular and pedestrian, to the site of the work and all adjacent areas. The Work shall be performed in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building material and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of any area of the building adjacent to the site of the Work, or the building, in the event of partial occupancy.

**§ 3.13.2** Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including without limitation, lavatories, toilets, entrances, and parking areas, other than those designated by the Owner. The Contractor shall comply with all rules and regulations established by the Owner in connection with the use and occupancy of the Project site and the Building.

### **§ 3.14 Cutting and Patching**

**§ 3.14.1** The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

**§ 3.14.2** The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

### **§ 3.15 Cleaning Up**

**§ 3.15.1** The Contractor shall, on a daily basis, keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project. See specification section 01 71 50 for specific requirements of final cleaning.

**§ 3.15.2** If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

**§ 3.15.3** Prior to the Architect's inspection for Substantial Completion, the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; clean roofs; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

### **§ 3.16 Access to Work**

The Contractor shall provide the Owner and Architect a job site plan and access to the Work, in preparation and progress wherever located.

### **§ 3.17 Royalties, Patents and Copyrights**

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

### **§ 3.18 Indemnification**

**§ 3.18.1** To the fullest extent permitted by law and to the extent claims, damages, losses or expenses are not covered by Project Management Protective Liability insurance purchased by the Contractor in accordance with Section 11.3, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, Third Party consultants, utility service providers involved with the project, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18.

**§ 3.18.2** In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

### **§ 3.19 Substitutions of Materials, Products, or Systems**

**§ 3.19.1** The materials, products, and the systems covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equivalent or better materials, products, or systems provided that same meets the requirements of the particular project and is approved in an addendum as a substitution prior to the submission of proposals. If prior written approval has not been obtained, it will be assumed that the Proposal is based upon the materials, products, and systems described in the Proposal Documents and no substitutions will be permitted, except as provided hereinafter.

**§ 3.19.2** If, prior to submitting his Proposal, a Proposer at any level determines that any of the materials, products, or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Proposer shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes shall be set forth in an addendum.

**§ 3.19.3** The Architect does not bind himself to consider a substitution during the proposal period unless written

request has been submitted to the Architect for approval at least ten (10) days prior to the date for receipt of Proposals. Each such request shall include a "side-by-side" comparison which may include but is not limited to the following; a complete description of the proposed substitute, the name of the material, project, or system for which it is proposed to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. Incomplete submittals will not be evaluated. If the Architect approves any proposed substitution, such approval will be set forth in an Addendum.

**§ 3.19.4** If, after award of contract, the Contractor or one of his Subcontractors or Suppliers determine that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Contractor shall promptly notify the Architect, in writing, providing detailed substantiation for his position. Any changes deemed necessary by the Owner and Architect, including substitution of materials and change in Contract Sum, either upward or downward, if any, shall be accomplished by appropriate modification.

### **§ 3.20 Record Drawings**

**§ 3.20.1** Within seven (7) days after substantial completion of the project, the Contractor shall submit two (2) sets of full-size photocopies of the Job Superintendent's field set of marked plans and specifications.

**§ 3.20.2** The Contractor shall provide the Owner with Electronic Record Drawings on a thumb drive or solid-state media drive. Drawings shall mirror the construction document sheets with any additions and changes made during the course of the project. Drawings shall be in both AutoCAD version 18 or later, and PDF or Tiff Format. CAD files shall have all referenced drawings in the same directory or folder. The record drawings shall include electronically all changes made during construction, clouded and keyed to identify the instrument of the change, Change Proposal Request or Change Order. For underground utility piping, revised locations shall also be dimensioned from the column grid lines. The record drawings must be delivered to the Architect at least thirty (30) days prior to receipt of the Contractor's Final Application for Payment. The record drawings shall have a statement added to indicate the purpose of the drawings (i.e. "RECORD DRAWINGS") and shall delete the Architects and/or Engineers seal. See additional requirements in Form 'AO'.

**§ 3.20.3** The Contractor is to provide the Owner with Record Specifications (one (1) PDF format on thumb drive or solid-state media drive) which denotes the manufacture of materials incorporated into the Project where more than one acceptable manufacturer is listed, and shall include all changes made during construction, clouded and keyed to identify the instrument of change. The record specifications shall have a statement added to indicate the purpose of the specifications (i.e. "RECORD SPECIFICATIONS"). See additional requirements in Form 'AO'.

### **§ 3.21 Antitrust Violations**

**§ 3.21.1** To permit the Owner to recover damages suffered; in antitrust violations, the Owner/Contractor Agreement shall include the following wording, "Contractor hereby assigns to Owner any and all claims for overcharges associated with this contract which are under the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et.seq. (1973)". The Contractor shall include this provision in his agreements with each subcontractor and supplier. Each subcontractor shall include such provisions in agreements with sub-subcontractors and suppliers

### **§ 3.22 Prevailing Wage Rates**

**§ 3.22.1** No employee used in this construction may be paid less than the minimum wage rate provided herein in Article 15.

### **§ 3.23 Construction Progress Photographs**

**§ 3.23.1** Contractor shall provide color construction progress photographs during the construction period on a monthly basis to the Architect and Owner. Photographs and digital files on thumb drive or solid-state media drive of photos shall be provided. Construction progress monthly photographs (24 minimum per month, showing all aspects of work accomplished during that month) shall be provided with each and every application for payment.

**§ 3.23.2** For New Construction, Building Additions and Miscellaneous Renovations provide (Digital files on thumb drive or solid-state media drive):

Two (2) aerial photographs prior to construction

Two (2) aerial photographs after Final Completion, and

Two (2) aerial photographs of the District facility site each month that there is a change in appearance of the

building exterior and site, or as requested by the Owner.

#### **ARTICLE 4 ADMINISTRATION OF THE CONTRACT**

##### **§ 4.1 Architect**

**§ 4.1.1** The Architect is the person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative.

**§ 4.1.2** Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

**§ 4.1.3** If the employment of the Architect is terminated, the Owner shall employ a new Architect against whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the former Architect.

**§ 4.1.4** Except as expressly provided herein, the Contractor shall not be relieved of Contractor's obligation to perform the Work in strict accordance with the Construction Documents and the Contract Documents by the duties, responsibilities, or activities of the Architect.

##### **§ 4.2 Architect's Administration of the Contract**

**§ 4.2.1** The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the one-year period for correction of Work described in Section 12.2. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents unless otherwise modified in writing in accordance with other provisions of the Contract.

**§ 4.2.2** The Architect shall visit the site at least twice per week (or more per week when deemed necessary by the Owner's Superintendent or Designee or when necessary to protect Owner's interests) and at any other intervals appropriate to the stage of construction, to inspect the progress, quantity and quality of the Work completed, to reject any observed nonconforming Work, and to determine if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Construction Documents and the Contract Documents and on time. Furthermore, a minimum of two job site meetings per month from commencement of construction through Final Completion will be initiated by the Architect and attended by the Contractor. Attendees will include Owner, the Contractor's project manager and/or superintendent, Architect's project representative, and Architect. The Architect, Owner and their representatives shall at all times have access to the Work. Architect, or its structural consultant will provide on-site observation prior to and during all concrete pours that contribute to the structural integrity of the building, including all pours of concrete piers, footings, grade beams, floor slabs, and concrete superstructure components, if applicable. In addition, Architect or its structural consultant will provide on-site observation prior to covering up or closing up of portions of the construction, which if covered, would conceal problems with the structural integrity of the Project. Contractor shall not close or cover said Work until said observations have occurred. Contractor or Architect will advise Owner of the need for any third-party laboratory or testing services to assist the Architect and Owner. On the basis of the on-site observations by Architect, Architect shall keep Owner and Contractor informed of the progress and the quality of the Work, through Architect's field reports, and shall guard Owner against defects and deficiencies in the Work. Architect shall promptly notify Owner and Contractor, orally, regarding any defect or nonconforming Work, which shall be followed by notice in writing of defects or nonconforming Work noted and corrective action taken or recommended. The Architect, however, shall not have control over, or responsibility for the Contractor's construction means, methods, techniques, sequences, procedures, or safety programs, but this does not relieve Architect of Architect's responsibilities under this Agreement. Any services by Contractor made necessary by Contractor's construction defect or nonconforming Work, shall be performed at no additional cost to Owner.

**§ 4.2.3** The Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be

responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work. The Architect shall endeavor to guard the Owner against defects and deficiencies in the Work.

**§ 4.2.4 Communications Facilitating Contract Administration**

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

**§ 4.2.5** Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

**§ 4.2.6** The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require additional inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

**§ 4.2.7** The Architect will review, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness as to cause no delay in the work or in the activities of the Owner, Contractor, or Subcontractor, while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

**§ 4.2.8** The Architect will prepare Change Orders, Change Proposal Requests, and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4.

**§ 4.2.9** The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; will receive and forward to the Owner for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

**§ 4.2.10** If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site.

**§ 4.2.11** The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them.

**§ 4.2.12** Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations

and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Contractor shall not cover up any work without the Architect and Owner performing an observation of such work. The Contractor will be responsible for any and all associated costs to allow for observations of the work, uncovered, by the Architect and Owner if the Contractor covers work without either the consent of the Architect and Owner or without providing the Architect and Owner with reasonable opportunity to observe the work, whether or not such work is found to be acceptable by the Architect or Owner.

### § 4.3 Claims and Disputes

§ 4.3.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner, Architect and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 4.3.2 Time Limits on Claims. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be initiated by written notice to the Architect and the other party.

§ 4.3.3 Continuing Contract Performance. Pending final resolution of a Claim unless as otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract.

§ 4.3.4 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within twenty-one (21) days after the Architect has given notice of the decision. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Section 4.4.

§ 4.3.5 Claims for Additional Cost. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.6.

§ 4.3.6 If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with this Section 4.3.

### § 4.3.7 Claims For Additional Time

§ 4.3.7.1 If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

§ 4.3.7.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 4.3.8 Injury or Damage to Person or Property. If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 4.3.9 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 4.3.10 Claims for Consequential Damages. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes without limitation:

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 4.3.10 shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

#### § 4.4 Resolution of Claims and Disputes

§ 4.4.1 Decision of Architect. Claims, including those alleging an error or omission by the Architect, shall be referred initially to the Architect for recommendation. If the parties are unable to agree, an appeal may be submitted as stated in Section 4.4.1.1 below.

§ 4.4.1.1 Any claim, disputes or matters arising out of this contract between the Architect, Owner and Contractor or any combination of those parties shall be submitted to a court of appropriate jurisdiction.

§ 4.4.2 The Architect will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following preliminary actions: within ten (10) days of receipt of claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Architect expects to take action, (3) reject the Claim in whole or in part, stating the reasons for rejection, (4) recommend approval of the Claim by the other party, or (5) suggest a compromise.

§ 4.4.3 In evaluating Claims, the Architect may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Architect in rendering a decision. The Architect may request the Owner to authorize retention of such persons at the Owner's expense.

§ 4.4.4 If the Architect requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten (10) days after receipt of such request, and shall either provide a response on the requested supporting data, advise the Architect when the response or supporting data will be furnished or advise the Architect that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Architect will either reject or approve the Claim in whole or in part.

§ 4.4.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be final and binding on the parties but subject to mediation.

§ 4.4.6 Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect or the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Architect or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 4.4.7 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines prior to resolution of the Claim by the Architect, or by mediation.

§ 4.4.8 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Architect, the Architect will notify the parties in writing that the Architect's decision will be made within seven (7) days.

Upon expiration of such time period, the Architect will render to the parties the Architect's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be possibility of a Contractor's default, the Architect shall notify the surety and request the surety's assistance in resolving the Claim.

#### § 4.5 Mediation

§ 4.5.1 Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Sections 4.3.10, 9.10.4 and 9.10.5 shall, after initial decision by the Architect or 30 days after submission of the Claim to the Architect, be subject to mediation only upon the mutual consent of both parties. In the event that mutual consent is not achieved, the parties are free to pursue any claims, disputes or matters in any manner allowed by law.

§ 4.5.2 Mediation, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect. Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association.

§ 4.5.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

### ARTICLE 5 SUBCONTRACTORS

#### § 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

#### § 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 As soon as practicable after award of the Contract, but not later than five (5) days prior to the submittal date for the Contractor's first Application for Payment, the Contractor shall furnish in writing to the Owner and the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. Where subcontractors have been listed in the Specifications or on the Contractor's Proposal Form, the proposed entities shall be those firms listed in the Specifications and on the Contractor's Proposal Form, unless an agreement has been reached with the Owner to accept a proposed substitute(s). The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no objection. Failure of the Contractor to submit the subject names in a timely manner will delay processing of the Contractor's Application for Payment.



§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made a timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made an objection under provisions of Subparagraph 5.2.1.

§ 5.2.3 If the Contractor has acted promptly and responsibly in submitting names as required, and the Owner or Architect objects to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no objection. The Contract Sum shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work.

§ 5.2.4 Prior to any substitution of a subcontractor by the Contractor, the Contractor shall notify the Architect of his intent and reasons for such proposed substitutions. The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect objects to such change.

§ 5.2.5 The Contractor shall submit the list of proposed Subcontractors on AIA Document G805 or the form provided in the Project Manual.

§ 5.2.6 The Contractor is required to visit the site and completely familiarize himself with the existing conditions prior to the proposal. Neither additional increase in the Contract Sum nor extension in Contract Time will be granted when existing or known conditions require a certain amount of work to comply with the intent of the Contract Documents.

### § 5.3 Subcontractual Relations

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. The Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors. Each subcontractor shall provide proof of insurance to Contractor consistent with the Contractor's insurance to Owner and in an amount commensurate with the Work to be performed by the Subcontractor.

### § 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.5 Neither the Owner nor the Architect shall be obligated to pay or to ensure the payment of any monies to subcontractors due to any non-payment to the Contractor or non-payment of subcontractors by the Contractor.

## **ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

### **§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts**

**§ 6.1.1** The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Section 4.3.

**§ 6.1.2** When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

**§ 6.1.3** The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

**§ 6.1.4** Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

### **§ 6.2 Mutual Responsibility**

**§ 6.2.1** The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

**§ 6.2.2** If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

**§ 6.2.3** The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

**§ 6.2.4** The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

**§ 6.2.5** The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

### **§ 6.3 Owner's Right to Clean Up**

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

## **ARTICLE 7 CHANGES IN THE WORK**

### **§ 7.1 General**

**§ 7.1.1** Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Change Proposal Request, Construction Change Directive, order for a minor change in

the Work, or a Change Proposal Request issued by Architect or Contractor, signed by Owner, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

**§ 7.1.2** All Change Orders and Change Proposal Requests shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

**§ 7.1.3** Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Change Proposal Request Construction Change Directive or order for a minor change in the Work.

## **§ 7.2 Change Orders**

**§ 7.2.1** A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

**§ 7.2.2** The parties mutually may agree upon a Change Order that adjusts Contract Time and/or Contract Sum based on a change in the Scope of Work requested by the Owner or that results from unanticipated, extraordinary adverse weather conditions as described in Article 15 of these General Conditions. The parties further agree that Contractor shall proceed with the Work only as set forth in a Change Order upon Contractor's physical receipt of a Change Order duly executed by the Owner. Contractor shall be entitled to reimbursement of a previously agreed to cost for estimating services.

**§ 7.2.3** If a change in the Work is to be ordered, a written request shall be issued by Owner to Contractor describing the change and requesting the submission of a Change Order Request. When time does not permit the processing of a Change Order in advance of commencing the change in the Work, upon receipt of a written authorization from Owner, Contractor shall proceed with a change in the Work pursuant to a Construction Change Directive and Contractor shall concurrently proceed with submission of a Change Order Request.

**§ 7.2.4** Within thirty (30) days following receipt of a written request, Contractor shall submit a Change Order Request to Owner together with the revised or new documents which, if approved, will become part of the Contract Documents setting forth any requested adjustment in the Contract Sum or the Contract Time, and including an itemization of all costs of material and labor with extensions listing quantities and total costs, and a substantiation of any Claim for an extension of the Contract Time. Any Change Order for a change in the work must be signed by the Owner before the Owner is obligated for payment related to the Change Order. If Contractor is unable to submit the above information within the time limit, it shall notify Owner in writing, setting forth for Owner's approval a date by which Contractor will submit the information as well as a schedule for the performance of the Work for which a Change Order Request will be forthcoming. If within the 30 days the Construction Manager cannot ascertain the financial or time impact of a claim a letter alerting the Owner of a forthcoming claim will suffice. This must be sent during this 30-day window.

**§ 7.2.5** If Owner accepts a Change Order Request submitted by Contractor, Contractor shall prepare a Change Order that is based upon such Change Order Request for execution by Contractor and Owner and to the extent that the Owner and Contractor agree, the Contract Sum and Contract Time shall be adjusted as provided in the Change Order upon execution of such Change Order.

**§ 7.2.6** Nothing contained herein shall limit the right of Owner to order changes in Work by Change Orders that have not been signed by Contractor, and Contractor shall promptly perform all Work required under the Contract Documents or a Change Order despite its failure to execute the Change Order. However, the Owner shall issue and execute a Change Order authorizing payment for all undisputed amounts.

**§ 7.2.7** No change in the Work shall be the basis of an addition to the Contract Sum or a change in the Contract Time unless and until such change has been authorized by a Change Order executed and issued by the Owner in

accordance with the Contract Documents. Changes in the Work may be made without notice to Contractor's sureties and absence of such notice shall not relieve such sureties of any of their obligations to Owner.

§ 7.2.8 Acceptance of a Change Order by the Contractor shall constitute full accord and satisfaction for any and all Claims, whether direct or indirect, including but not limited to, impact or delay damages, arising from the subject matter of the Change Order; or attorneys' fees and costs arising from a dispute with a Subcontractor over the Change Order.

§ 7.2.9 Methods used in determining adjustments to the Contract Sum shall be those listed in Section 7.3.3.

### § 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive and/or Change Proposal Request shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 The cost or credit to the Owner resulting from a change in the Work shall be determined in one or more ways listed below. The first method listed shall be used unless the Architect determines that the method is inappropriate, in which case another method shall be selected:

- .1 By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation. Contractor shall provide on company letterhead backup documentation and submit proposal cost and/or by either using unit costs method with attached supporting data or by using labor, materials and equipment method with attached supporting data. One form shall be utilized by each trade involved in the change in the work with an overall summary form by the Contractor for the entire change. Where additional Work is involved, the lump sum shall represent the estimated cost of labor and materials; plus markups to cover miscellaneous fees and profit if not funded by an allowance:

To compensate the Contractor or Subcontractor actually performing a part of the Work for the combined cost of miscellaneous fees and profit, the performing party shall be entitled to a single markup not to exceed 15% of the estimated cost of that part of the Work.

To compensate the Contractor for the combined cost of miscellaneous fees and profit on work performed by Subcontractors, the Contractor shall be entitled to a single markup not to exceed 10% of the subcontract amount if not funded from an allowance. (Contractor shall not be allowed a markup for miscellaneous fees and profit if change is funded by an allowance.)

When a Sub-subcontractor performs the Work of a change, the 15% markup for combined miscellaneous fees and profit shall be used only by the Sub-subcontractor. The Subcontractor and Contractor would each be entitled to a single markup not to exceed 10% of the cost to them from the Subcontractor and sub-subcontractor respectively if not funded by an allowance. (Contractor shall not be allowed a markup for miscellaneous fees and profit if change is funded by an allowance.)

- .2 By unit prices stated in the Contract Documents or subsequently agreed upon; Additional markups for miscellaneous fees, and profit will not be allowed in Unit Price Work;
- .3 By cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Subsection 7.3.6.
- .5 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above on company letterhead. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization.

- .6 For changes in the work the Contractor, Owner and Architect agree to be bound by the below stated required time lines.

Upon issuance of a Change document, Contractors, Subcontractors and Sub-subcontractors shall provide the proposed pricing on company letterhead with the required supporting back up documentation no later than fifteen (15) business days after receipt of the proposed change document. Architect and Owner shall review Contractor's pricing and within ten (10) business days accept pricing as submitted by the Contractor or reject the pricing and return to the Contractor with specific reasons for rejections. If pricing is rejected, Contractor shall review the specific rejections and modify pricing to address the specific rejection and resubmit to the Architect and Owner comments within two (2) business days after receipt of rejection comments. The Architect and Owner shall review the revised pricing and either accept the revised pricing, or if pricing is still in dispute, the Architect shall issue a Construction Change Directive.

§ 7.3.4 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.5 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.6 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect or Owner shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for miscellaneous fees, overhead and profit except if funded by Allowance. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

- .1 costs of labor, including social security, retirement and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .2 costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- .3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others, and;
- .4 additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.7 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for miscellaneous fees and profit shall be figured on the basis of net increase or decrease, if any, with respect to that change.

§ 7.3.8 Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by an approved Change Order or Change Proposal Request indicating the parties' agreement with part or all of such costs. For any portion of such costs that remains in dispute, the Architect will make an interim determination for purposes of monthly certification for payment for those costs. The determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 4.

§ 7.3.9 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

## **§ 7.4 Minor Changes in the Work**

**§ 7.4.1** The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents with Owner's written approval. Such changes will be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly with Owner's written approval.

## **§ 7.5 Changes Funded by Allowances**

**§ 7.5.1** Allowance balances may be used to fund changes in the work. The Contractor will not be allowed a mark-up for overhead and profit when changes in the work are funded by one of the Allowances. Cost for changes funded by allowances shall be determined by methods described in Article 7.3.3. Miscellaneous fees and profit mark-up shall be allowed on work performed by Subcontractors, Sub-subcontractors and the Contractor's own forces, in accordance with Section 7.2 and 7.3.

**§ 7.5.2** Changes funded by Allowances shall require back-up documentation per Section 7.3.3.

## **ARTICLE 8 TIME**

### **§ 8.1 Definitions**

**§ 8.1.1** Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

**§ 8.1.2** Unless agreed otherwise, the date inserted on the Agreement form and the Date of Commencement constitute "0" (zero) of the stated Completion Time.

**§ 8.1.3** The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

**§ 8.1.4** The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined. The term "regular working day" as used in the Contract Documents shall mean any day from Monday through Friday, exclusive of those holidays normally recognized in the construction industry and/or approved by District-approved calendar.

### **§ 8.2 Progress and Completion**

**§ 8.2.1** Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

**§ 8.2.2** The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner, and approved by the Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance. Unless the date of commencement is established by the Contract Documents or a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five (5) days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

**§ 8.2.3** The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

### **§ 8.3 Delays and Extensions of Time**

**§ 8.3.1** If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by fire, or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect and Owner determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect and Owner may determine.

**§ 8.3.2** Claims relating to time shall be made in accordance with applicable provisions of Article 4.

**§ 8.3.3** This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

§ 8.3.4 Extensions of time granted for causes described herein will be granted on the basis of one Regular Working Day extension for each Regular Working Day lost (i.e. seven (7) Calendar Days extension will be granted after five (5) Regular Work Days are lost except as modified by the provisions contained herein related to Anticipated Weather days).

§ 8.3.5 Each Proposer shall include in his proposed construction schedule an allowance of regular work days per year as defined in 1.7.7.4, in which work is delayed for student testing or other unspecified campus events. In addition, each proposer shall include an allowance of Anticipated Weather Days in accordance with following:

Number of anticipated Weather Days (These are regular working days)

January	5	July	8
February	5	August	8
March	5	September	7
April	4	October	4
May	7	November	6
June	7	December	5

§ 8.3.6 Weather Days shall pertain to such items as rain, flooding, snow, unusually high winds, excessively wet grounds, or the like which prevent progress on major portions of the work on regular working days only. If such situations occur on more than the number of Anticipated Weather Days indicated above and if those additional days prevent the Contractor from performing critical portions of the scheduled work, extensions of time cause by inclement weather may be requested as enumerated hereinafter: if the inclement weather is rain related, the rain at the site must have been in excess of 0.5 inch in 24 hours.

§ 8.3.7 At the beginning of each month the Contractor shall submit a status report for the preceding month, showing 1) the scheduled number of Anticipated Weather Days for the particular month, 2) the actual Weather Days requested, and 3) the Net Weather Days (plus, minus, or no change). At times deemed appropriate by the Architect or when requested in writing by the Contractor, the Contract time will be adjusted by Change Order if the total of Net Weather Days is substantially greater than "0". Unused Anticipated Weather Days may be accumulated during the Contract Time and may be used to offset Actual Weather days in other months. If the Contractor fails to submit said monthly status report, it will be assumed that none of the Anticipated Weather Days were used for that month and that they shall accumulate for possible future offset against Net Weather Days; however, if at the end of the project all Anticipated Weather days have not been used, the contract completion time will not be reduced. An example of the monthly schedule to be submitted is as follows:

Month	Anticipated Weather Days (Regular)	Actual Weather Days (Regular) Requested	Net Weather Days (Regular)
January	5	11	6
February	5	0	-5
March	5	2	-3
April	4	2	-2
May	7	12	5
June	7	11	4
<b>Totals</b>	<b>33</b>	<b>38</b>	<b>5</b>

Using this example (and assuming that all requested days were approved) there were 5 Net Weather Days (regular) for the six (6) months of the project and the extension of Contract Time would be seven (7) Calendar Days).

§ 8.3.8 Extensions of the Contract Time will only be considered after the number of anticipated delay days has been expended through mutual agreement by the Owner, Architect and Contractor.

§ 8.3.9 The following is a requirement of the Contract and will be included in the Agreement Between Owner and Contractor under Time of Completion and the blank spaces will be completed indicating the completion date as stated on the Proposal Form.

§ 8.3.10 The Work to be performed under this Contract shall be commenced in accordance with Section 8.1.2 and the following Substantial Completion Date(s) must be achieved. Refer to the Project Manual for description of Phasing, if any.

1. Refer to Document A101-2017 Standard Form of Agreement Between Owner and Contractor as amended, Article 3.3 for required substantial completion date(s).

The parties hereto agree that time is of the essence of this Contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not achieve the phased construction completion called for in the Contract Documents by the specified dates, are in their very nature difficult to ascertain. Refer to Section 8.4 for Liquidated Damages.

#### § 8.4 Liquidated Damages

§ 8.4.1 The parties hereto agree that time is of the essence of this Contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not achieve the phased construction completion called for in the Contract Documents by the specified dates, are in their very nature difficult of ascertainment. The sums per Calendar Day to be paid in consideration of all actual costs such as rental costs, additional supplies, labor, overtime, and especially disruption of the educational programs and lost administrative time, which cannot be readily determined are as follows:

Elementary Schools (New Construction and/or Renovations):	\$1,000.00/Calendar Day
Middle Schools (New Construction and/or Renovations):	\$2,000.00/Calendar Day
High Schools (New Construction and/or Renovations):	\$3,000.00/Calendar Day
Athletic Fields (New Construction and/or Renovations):	\$1,000.00/Calendar Day
Miscellaneous Facilities (New Construction and/or Renovations):	\$1,000.00/Calendar Day

§ 8.4.1.1 It is therefore expressly agreed as a part of the consideration inducing the Owner to execute this Contract that the Owner may deduct from the Final Payment made to the Contractor an equitable sum per Calendar Day for each and every Calendar Day beyond the specified date of Substantial Completion, which the Contractor shall require for Substantial Completion of the Work included in this Contract. It is expressly understood that said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the work is not completed within the agreed time, or within the legally extended time, if any, otherwise provided for herein. Said sum shall be considered as Liquidated Damages only and in no sense shall be considered a penalty, said damages being caused by additional compensation to personnel, for loss of interest on money, and other increased costs, all of which are by their nature difficult of exact ascertainment.

§ 8.4.1.2 If the Contractor fails to complete all requirements of Final Completion within ninety (90) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the job site or Owner's office until such time as the close-out documents and all punch list items are completed and accepted by Owner. During this time the General Contractor will be charged for the Owner's, Architect's, and any consultant's time. Billable time will include without limitation travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions. These weekly meetings shall include a minimum two (2) hour charge per participant. Costs will be deducted from Contractor's Final Payment. Hourly rates shall be as follows:

#### Consultants:

- Principal Architect/Engineer/Consultant: \$175.00
- Project Architect/Engineer/Consultant \$150.00
- Staff Architect/Engineer/Consultant \$120.00



- Field Representative/Architect/Engineer/Consultant \$100.00
- Secretarial \$ 50.00

**Project Owner:**

- Associate Superintendent \$225.00
- Assistant Superintendent \$200.00
- Director \$175.00
- Senior Project Manager \$165.00
- Project Manager \$150.00
- Project Coordinator \$120.00
- Secretarial \$ 50.00
- Maintenance Technician \$ 50.00
- Operations Personnel \$ 33.00

**ARTICLE 9 PAYMENTS AND COMPLETION**

**§ 9.1 Contract Sum**

**§ 9.1.1** The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

**§ 9.2 Schedule of Values**

**§ 9.2.1** Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect and Owner may require. This schedule, unless objected to by the Architect or Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment.

**§ 9.2.2** In order to facilitate the review of Applications for Payment, the Schedule of Values shall be submitted on AIA Documents G702 and G703 or other similar forms approved by the Owner, and shall include the following:

- .1 General Contractor's costs for Contractor's fee, bonds and insurance, mobilization, project close-out etc., shall be listed as individual line items.
- .2 Contractor's costs for various construction items shall be detailed. For example, concrete Work shall be subdivided into footings, grade beams, floor slabs, paving, etc. These subdivisions shall appear as individual line items.
- .3 On major subcontracts, such as mechanical, electrical, plumbing, and low voltage, the schedule shall indicate line items and amounts in detail (e.g. underground, major equipment, fixtures, installation of fixtures, start up, close-out, etc.)
- .4 Costs for subcontract Work shall be listed without any addition of General Contractor's costs for miscellaneous fees, profit or supervision.
- .5 Where payment for stored materials may be requested prior to installation, material and labor shall be listed as separate line items. Stored materials will only be paid for the amount of actual invoices of same materials.
- .6 Sample pages from an approved schedule of values are included in Section 01 29 73 of the project specifications.
- .7 Where work occurs at more than one building, for the Owner's accounting purposes and to facilitate the checking and verification of the Contractor's Application for Payment, cost shall be scheduled separately for each building on the G703 Continuation Sheets. Building additions and renovations shall be listed separately.
- .8 All work outside the building envelope excluding overhangs and canopies shall be listed separately

under Site work.

### § 9.3 Applications for Payment

§ 9.3.1 At least ten (10) days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. Prior to this submittal, the Contractor shall contact the Architect's Field Department and Owner for on-site review of the proposed application. On-site reviews shall include review of all lien releases and stored materials. See project manual for additional requirements. Upon approval by the Architect's Field Department and Owner, the Application for Payment shall be notarized and submitted to the Architect. Included shall be data required to support lien releases, Application for Payment Checklist (Section CA), invoices and/or receipts. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.8, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Change Proposal Requests, but not yet included in Change Orders.

§ 9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work and 2) Suitably stored at the site or 3) suitably stored at some off-site location provided the following conditions are met for off-site storage:

- .1 The location must be agreed to, in writing, by the Owner and Surety.
- .2 The location must be a bonded warehouse.
- .3 Surety must agree, in writing, to each request for payment.
- .4 The Contractor must bear the cost of the Owner's and Architect's expenses related to visiting the off-site storage area.
- .5 All items shall be marked and clearly tagged as property of the Owner.

Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance (naming the Owner as insured) and transportation to the site for those materials and equipment. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment. Contractor shall only be paid for the amount of the actual invoices submitted as backup for stored materials.

The Contractor acknowledges that the review of materials stored off site is an additional service of the Architect and shall be charged for that service. The cost for that service will be established by the Architect and is not subject to appeal.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.3.4 Contractor's progress payment draws for fees and general conditions (including miscellaneous fees and profit) shall not exceed the percentage completion of the Work in place for the entire Project as indicated on the Application for Payment.

§ 9.3.4.1 By signing each Application for Payment, Contractor stipulates and certifies the following: that the information presented is true, accurate, and complete; that the Contractor has made the necessary detailed examinations, audits, and arithmetic verifications that the submitted Work has been completed to the extent represented in the Application for Payment, that the materials and supplies identified in the Application for Payment have been purchased, paid for, and received; that the subcontractors have been paid as identified in the Application for Payment or that the Contractor has been invoiced for same; that he has made the necessary on-site inspections to confirm the accuracy of the Application for Payment; that there are no known mechanics' or materialmen's liens outstanding at the date of this requisition; that all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current application; that except for such bills not paid but so included, there is no known

basis for the filing of any mechanics' or materialmen's liens on the Work; that the Payment Application includes only Work self-performed by Contractor or for which Contractor has been invoiced; and that releases from all subcontractors and materialmen have been obtained in such a form as to constitute an effective release of lien under the laws of the State of Texas covering all Work performed and for which payment has been made by the Owner to the Contractor.

**§ 9.3.5** Contractors shall submit digitally one (1) application using AIA Document G702 and G703, Application and Certificate for Payment, 1992 Edition. All blanks in the form must be completed and signatures of Contractor and Notary Public must be original on each form.

**§ 9.3.6** Contractor shall submit Application to the Architect in sufficient time (no later than Thursday at noon) to ensure that the Architect submits Application to the Owner on the first Monday of the Month (or previous business day if Monday is a Holiday as defined in this Agreement), prior to 12:00 pm. Applications will not be accepted on any other day of the week.

#### **§ 9.4 Certificates for Payment**

**§ 9.4.1** The Architect will, within seven (7) days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

**§ 9.4.3** The Architect will affix his signature to the same form described in Paragraph 9.3.4 to signify his certification of payment provided the application is otherwise satisfactory.

**§ 9.4.4** The issuance of a Certificate for Payment shall constitute a recommendation to the Owner regarding the amount to be paid, this recommendation is not binding on the Owner if the Owner knows of other reasons under the Contract Documents why payment should be withheld.

#### **§ 9.5 Decisions to Withhold Certification**

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1** defective Work not remedied;
- .2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3** failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 persistent failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

### § 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven (7) days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 9.6.5 Payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Based upon Applications for Payment and supporting documents including monthly updates of record drawings submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided in the conditions of the Contract as follows:

95% of the proportion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the Work and 95% of the portion of the Contract Sum properly allocable to materials and equipment suitably stored at the site or at some other location agreed upon in writing by the parties; less the aggregate of previous payments in each case; and upon Substantial Completion of the entire work, a sum sufficient to increase the total payments to 95% of the Contract Sum less such retainages as the Architect shall determine for all incomplete work and unsettled claims.

Owner reserves the right to require that conditional Lien Releases be submitted by the Contractor and all subcontractors, sub-subcontractors and major suppliers with each Application for Payment after the first Application for Payment for which payment was made by the Owner for the certified amount for all previous applications for payments. Owner may withhold payment on-line items for which a lien or claim (or similar notice of intent) has been filed, until satisfactory release has been received by Owner.

Contractor shall not withhold as retainage a greater percentage for the Subcontractors or materialmen than the percentage that Owner withheld as retainage from payments to the Contractor.

### § 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment or notify Contractor of rejection, through no fault of the Contractor, within seven (7) days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven (7) days after the date established in the Contract Documents the amount certified by the Architect, then the Contractor may, upon seven (7) additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.7.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, then such payment shall be made promptly upon demand by the Owner. Any payments that are past due more than thirty (30) days after the Owner's invoice date may result in owner's rejection of Application for Payment.

### § 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work is sufficiently complete for the Owner to occupy, operate, and maintain the Work. Owner and Architect shall make the final determination as to which provisions of the Contract Documents are necessary to meet this criteria, whether or not such requirements are specifically enumerated in this Section or in other portions of the Contract Documents as being specifically required for Substantial Completion.

§ 9.8.1.1 The following items are a partial list of requirements, as applicable to the Project, that must be completed prior to the established Substantial Completion. This is not intended to be an exhaustive list, but a guideline:

1. All fire alarm system components must be completed and demonstrated to the Owner.
2. All inspections by government authorities having jurisdiction over the project must have been finalized, any remedial work required by them must have been completed, and Certificates of Occupancy, local fire marshal and health department approval certificates and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
3. All exterior clean-up and landscaping must be complete, including required stand of grass mowed, edged, weeded, and fertilized.
4. All interior shall have been completed and cleaned except minor items which, if complete after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. Contractor shall provide list of these specific items, which include punch list and completion items. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect shall be the sole judge of what constitutes a significantly large number of items.
5. All third-party HVAC air and water balancing must be complete.
6. All energy management systems must be complete, fully operational and demonstrated to the Owner, with graphics transferred to the main server.
7. All emergency/standby generator and low voltage lighting control systems must be complete, fully operational and demonstrated to the Owner.
8. All security systems must be complete, fully operational and demonstrated to the Owner, and must be monitorable from the District's central Police/Security Center.
9. All school communications equipment, telephone systems and P.A. systems must be complete and demonstrated to the Owner.
10. All final lockset cores must be installed and all final Owner directed keying completed.
11. All room plaques and exterior signage must be complete.
12. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment and all life safety systems.
13. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
14. All operation and maintenance manuals are delivered and approved by Architect and Owner ("D-slant" ring binders in duplicate).
15. Health Department Inspections and Municipal Utility District (MUD) and Drainage District and

County approvals must be provided.

16. All other reports, testing results, certifications, studies, etc. required by Contract Documents.

**§ 9.8.2** When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

**§ 9.8.3** Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy, operate, and maintain the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

**§ 9.8.4** When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

**§ 9.8.5** The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

#### **§ 9.9 Partial Occupancy or Use**

**§ 9.9.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Article 11 and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

**§ 9.9.2** Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

**§ 9.9.3** Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

#### **§ 9.10 Final Completion and Final Payment**

**§ 9.10.1** Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, and the Owner agrees that all closeout requirements have been fulfilled, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**§ 9.10.2** Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.

**§ 9.10.3** Prior to final payment, the Contractor shall submit in triplicate (one (1) original and two (2) copies) to the Architect the following completed forms:

1. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706.
2. Contractor's Affidavit of Release of Liens, AIA Document G706A
3. Consent of Surety to Final Payment, AIA Document G707.
4. General Contractor's Guarantee - notarized
5. Subcontractor's Warrantees from each Subcontractor on Final Subcontractor List
6. All Subcontractors and suppliers and also any other parties that had submitted claims of non-payment shall submit Conditional Lien Releases – notarized. Executed document shall be dated within thirty (30) days of submission of final pay application.
7. Each Offeror (and Subcontractor and supplier submitting a proposal to an Offeror) shall submit a notarized affidavit stating that no asbestos, PCB or lead containing building materials were used on Owner's form.
8. Maintenance, inspection and warranty manuals. Two (2) sets of each bound in a 3-inch "D-slant" ring binder.
9. Record drawings. See Section 3.20.
10. Final Subcontractor List.
11. Refer to Specification Section 01 77 00, Guarantees, Certificates and Project Closeout for any additional information and requirements.
12. Executed TEA Project Compliance Certificate Form (Form 'AL').
13. Executed project Close-Out Form (Form 'AO'), and any additional provisions stated on Form 'AO' as being the responsibility of Contractor.

Documents identified as affidavit must be notarized. All documents requiring signatures must have original signatures (no stamps), and must indicate printed name of signer. All manuals will contain an index listing the information submitted. The index sections will be divided and identified by tabbing each section as listed in the index.

All Manufacturers' warranties must be on manufacturer's original form, indicating project name, and length of warranty.

The Owner may accept certain portions of the work as being complete prior to the acceptance of the entire project. If certain areas are accepted by the Owner as being complete, and if the Contractor has completed all of the requirements for final payment of that portion of work, the Owner may release retainage for that area/portion of work. Amounts of retainage shall be agreed upon by both Owner and Contractor prior to final acceptance of these areas.

Refer to Project Manual for additional requirements.

**§ 9.10.4** If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that

portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

**§ 9.10.5** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents; or
- .3 terms of special warranties required by the Contract Documents.

**§ 9.10.6** Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## **ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY**

### **§ 10.1 Safety Precautions and Programs**

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

**§ 10.1.1** Contractor's employees, agents, and Subcontractors and Sub-subcontractors shall not perform any service under this Contract while under the influence of alcohol or any controlled substance. Contractor, its employees, agents, and Subcontractors shall not use, possess, distribute, or sell illicit or unprescribed controlled drugs or drug paraphernalia, or misuse legitimate prescription drugs while performing the Work. Contractor, its employees, agents, and Subcontractors shall not use, possess, distribute, or sell alcoholic beverages while performing the Work.

**§ 10.1.2** Contractor has adopted or will adopt its own policy to assure a drug and alcohol-free workplace while performing the Work. Contractor will remove any of its employees from performing the Work any time there is suspicion of alcohol and/or drug use, possession, or impairment involving such employee, and at any time an incident occurs where drug or alcohol use could have been a contributing factor. Owner has the right to require Contractor to remove employees from performing the Work any time cause exists to suspect alcohol or drug use. In such cases, Contractor's employees may only be considered for return to work after the Contractor certifies as a result of a for-cause test, conducted immediately following removal that said employee was in compliance with this Contract. Contractor will not use an employee to perform the Work who either refuses to take, or tests positive in any alcohol or drug test.

**§ 10.1.3** Contractor will comply with all applicable federal, state, and local drug and alcohol related laws and regulations (e.g., Department of Transportation regulations, Department of Defense Drug-free Work-free Workforce Policy, Drug-Free Workplace Act of 1988). Owner has also banned the presence of all weapons on the Project Site, whether or not the owner thereof has a permit for a concealed weapon.

### **§ 10.2 Safety of Persons and Property**

**§ 10.2.1** The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

**§ 10.2.2** The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

**§ 10.2.3** The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.



§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. When use or storage of explosives or other Hazardous Substances (as hereinafter defined) or equipment or unusual construction methods are necessary, the Contractor shall give the Owner reasonable advance notice of the presence or use of such materials, equipment, or methods. Contractor shall be responsible for any Hazardous Substances Contractor or Contractor's employees, contractors, consultants, subcontractors, sub-subcontractors, materialmen, and suppliers use, store, or otherwise introduce to the Premises.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 The Contractor shall be responsible for taking all precautions necessary to protect the work in place from any weather conditions including without limitations to flooding, freezing, high winds, tropical storms, hurricanes, etc. which could cause any potential damage to portions or all work in place. The Contractor shall be responsible for performing all repairs and/or replacement of any work that results from such weather conditions.

### § 10.3 Hazardous Materials

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 If requested in writing by the Contractor, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to verify that it has been rendered harmless. If requested in writing by the Contractor or Architect, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection.

§ 10.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents.

### § 10.5 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Section 4.3.7.

### § 10.6 Asbestos, Lead or PCBs Containing Materials

**§ 10.6.1** The contractor and each subcontractor, **sub-subcontractor and suppliers** prior to final payment, shall submit an original notarized statement on their letterhead certifying "to the best of their information, knowledge, and belief asbestos-, lead-, and PCB-containing materials, and have not been used or incorporated into the Work and lead or lead-bearing materials have not been incorporated into potable water systems." For the purpose of definition as used in this statement, the term "potable water systems" includes, but is not limited to, those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibs, as applicable to the project.

**§ 10.6.2** To the best knowledge of the Owner, the Architect and his consultants, no products or materials containing asbestos or polychlorinated biphenyl (PCB) or other toxic substances have been specified for this project. No products or materials containing asbestos or PCB are to be incorporated in this project. In the event the Contractor or his Sub-contractors become aware that any products or materials specified, ordered, scheduled for or already incorporated in the work on this project, contain asbestos, or PCB, the situation shall be reported immediately to the Owner and Architect in writing. An acceptable, equal substitute for the product or material in question shall be proposed by the Contractor and the product or material in question, if already onsite or incorporated in the work, shall be removed from the site immediately and returned to the supplier or manufacturer.

## **ARTICLE 11 INSURANCE AND BONDS**

### **§ 11.1 Contractor's Liability Insurance**

**§ 11.1.1** Refer to Section BD - Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management. The Contractor and Contractor's Subcontractors shall purchase and maintain, in a company or companies licensed and admitted by the Texas Department of Insurance to engage in the business of furnishing insurance in the State of Texas, the types and amounts of insurance as set forth in Section BD of the Agreement to protect it and the Owner from claims that may arise out of, or result from, the Contractor's operations under the Contract, whether such operations be by itself, or by any Subcontractor, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. All insurance companies shall have an "A-VIII" in Best's Rating Guide and shall be satisfactory to the Owner. No Work will be commenced until all requirements of this Article have been approved by the Owner in writing.

**§ 11.1.2** The insurance required by Section BD - Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until dates specified in Section BD.

**§ 11.1.3** Original Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies required by this Section BD – Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty (30) days prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the Final Application for Payment as required by Section 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

### **§ 11.2 Owner's Liability Insurance**

**§ 11.2.1** The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

### **§ 11.3 Project Management Protective Liability Insurance**

**§ 11.3.1** Optionally, the Owner may require the Contractor to purchase and maintain Project Management Protective Liability insurance from the Contractor's usual sources as primary coverage for the Owner's, Contractor's and Architect's vicarious liability for construction operations under the Contract. Unless otherwise required by the Contract Documents, the Owner shall reimburse the Contractor by increasing the Contract Sum to pay the cost of purchasing and maintaining such optional insurance coverage, and the Contractor shall not be responsible for purchasing any other liability insurance on behalf of the Owner. The minimum limits of liability purchased with

such coverage shall be equal to the aggregate of the limits required for Contractor's Liability Insurance under Section 11.1.

§ 11.3.2 To the extent damages are covered by Project Management Protective Liability insurance, the Owner, Contractor and Architect waive all rights against each other for damages, except such rights as they may have to the proceeds of such insurance. The policy shall provide for such waivers of subrogation by endorsement or otherwise.

#### § 11.4 Performance Bond and Payment Bond

§ 11.4.1 The Owner requires the Contractor to furnish payment and performance bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract in a total amount equal to 100% of the Contract Sum and in conformity with applicable law. All bonds shall be issued by a surety company licensed, listed, and authorized to issue bonds in the State of Texas by the Texas Department of Insurance. The surety company may be required by the Owner to have a rating of not less than "B" in the latest edition of Best's Insurance Reports, Property-Casualty. The surety company shall provide, if requested, information on bonding capacity, other projects under coverage and shall provide proof to establish adequate financial capacity for the Project. Should the bond amount be in excess of ten percent (10%) of the surety company's capital and surplus, the surety company issuing the bond shall certify that the surety company has acquired reinsurance, in a form and amount acceptable to the Owner, to reinsure the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus with one or more reinsurers who are duly authorized and admitted to do business in Texas and that amount reinsured by a reinsurer does not exceed ten percent (10%) of the reinsurers capital and surplus.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.

§ 11.4.3 The Contractor shall deliver the required Bonds to the Owner not later than the date of the preconstruction meeting if the Contract has been executed by Owner. All Bonds will be reviewed and approved by the Owner for compliance with the Contract Documents prior to the Contractor mobilizing onsite. Upon Owner approval, the Contractor will be allowed to mobilize onsite.

§ 11.4.4 All bonds shall be originals. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney. The name, address, and telephone number of a contact person for the Bonding Company shall be provided.

§ 11.4.5 Bonds shall guarantee the faithful performance of all the covenants, stipulations, and agreements of the Contract. Bonds shall be signed by an agent resident in the State of Texas and date of bond shall be the date of execution of the Contract. If at any time during the continuance of the Contract, the surety of the Contractor's bonds becomes insufficient, the Owner shall have the right to require additional and sufficient sureties which the Contractor shall furnish to the satisfaction of the Owner within ten (10) days after notice to do so. In default thereof, all payment or money due to the Contractor may be withheld until Contractor provides additional surety.

§ 11.4.6 It is distinctly understood that no mechanic, contractor, Contractor, materialman, vendor, artisan or laborer, skilled or unskilled, shall have, claim or acquire any lien upon the Project or any of the improvements in the Project, nor upon any of the land upon which the Project is located.

### ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

#### § 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such

costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

## **§ 12.2 Correction of Work**

### **§ 12.2.1 Before or After Substantial Completion**

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

### **§ 12.2.2 After Substantial Completion**

**§ 12.2.2.1** In addition to the Contractor's obligations under Section 3.5, if, within one (1) year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

**§ 12.2.2.2** The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

**§ 12.2.3** The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

**§ 12.2.4** The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

**§ 12.2.5** Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

## **§ 12.3 Acceptance of Nonconforming Work**

**§ 12.3.1** If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## **ARTICLE 13 MISCELLANEOUS PROVISIONS**

### **§ 13.1 Governing Law**

**§ 13.1.1** The Contract shall be governed by Texas law and mandatory and exclusive venue for any disputes shall be in Harris County, Texas.

### **§ 13.2 Successors and Assigns**

**§ 13.2.1** The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the

Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

### § 13.3 Written Notice

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

### § 13.4 Rights and Remedies

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

### § 13.5 Tests and Inspections

§ 13.5.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect, their Consultants, or Owner's Third Party Consultant services, and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

### § 13.6 Commencement of Statutory Limitation Period

§ 13.6.1 As between the Owner and Contractor:

- .1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

- .2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and
- .3 After Final Certificate for Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Section 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Section 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

§ 13.7 Refer to Specification Sections 01 35 23, 01 35 23.1 and 01 35 23.2 - Special Owner Requirements for additional requirements to be included as part of the Contract.

§ 13.8 The Owner shall have the right to examine, copy and/or audit the books and other records in possession of the Contractor relating to this Contract at any time deemed necessary by the Owner.

## ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of sixty (60) consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven (7) days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work properly executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable miscellaneous fees, profit, and damages.

§ 14.1.4 If the Work is stopped for a period of sixty (60) consecutive Calendar Days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven (7) additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

### § 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards laws, ordinances, or rules and regulations, or orders of a public authority having jurisdiction; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.
- .5 fails to furnish the Owner, upon written request, with assurances satisfactory to the Owner, evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
- .6 engages in serious or repeated worker misconduct in violation of Article 3.3.2;
- .7 engages in conduct that would constitute a violation of state or federal criminal law, including but not limited to, the laws prohibiting certain gifts to public servants, or engages in conduct that would constitute a violation of the Owner's ethics or conflict of interest policies; or
- .8 fails to proceed continuously and diligently with the construction and completion of the Work, except as permitted under the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven (7) days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of the site and all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 The parties hereby agree that: 1) if an order for relief is entered on behalf of the Contractor, pursuant to Chapter 11 of the U.S. Bankruptcy Code; 2) if any other similar order is entered under any debtor relief laws; 3) if Contractor makes assignments for the benefit of one or more of its creditors; 4) if a receiver is appointed for the benefit of its creditors; or 5) if a receiver is appointed on account of its insolvency, any such event could impair or frustrate Contractor's performance of the Contract Documents. Accordingly, it is agreed that upon occurrence of any such event, Owner shall be entitled to request of Contractor or its successor in interest, adequate assurance of future performance in accordance with the terms and conditions of the Contract Documents. Failure to comply with such request within ten (10) days of delivery of the request shall entitle Owner to terminate the Contract and to the accompanying rights set forth in Subparagraphs 14.2.1 through 14.2.6. In all events, pending receipt of adequate assurance of performance and actual performance in accordance with the Contract Documents, Owner shall be entitled to proceed with the Work with Owner's own forces or with other Contractors on a time and material or other appropriate basis, the cost of which will be charged against the Contract Sum.

§ 14.2.4 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.5 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.2.6 Contractor hereby assigns the Owner any and all claims for overcharges associated with this Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. Section 1 ET.SEQ. (1973).

### § 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

**§ 14.4 Termination by the Owner for Convenience**

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment from the Owner on the same basis provided in Section 14.1.3.

**ARTICLE 15 LABOR STANDARDS**

**§ 15.1 PREVAILING WAGE RATES**

§ 15.1.1. Contractor, Contractor's Subcontractors and Sub-subcontractors shall pay all workers not less than the general prevailing rate of per diem wages for work of a similar character where the project is located as detailed in the "Minimum Wage Schedule" in section CB of the specifications, or as otherwise provided in the Contract Document. Wages listed are minimum rates only. However, no claims for additional compensation above the Contract Sum shall be considered by the Owner because of payments of wage rates in excess of the applicable rate provided herein. Texas Government Code § 2258.001 *et seq.*

§ 15.1.2 Contractor shall forfeit, as a penalty to the Owner, \$60 for each laborer, worker, or mechanic, employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the Contract Documents.

§ 15.1.3 Owner reserves the right to receive and review payroll records, payment records, and earning statements of employees of Contractor, and of Contractor's Subcontractors and Sub-subcontractors.

§ 15.1.4 If no prevailing wage rate schedule is made part of the Contract Documents, then the parties shall use the wage rate determined by the U.S. Department of Labor in accordance with the Davis-Bacon Act, 40 U.S.C. § 276a.



## SECTION 01 10 00

### SUMMARY OF WORK

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION OF WORK

- A. Project, **2022 Arnold MS Renovation**, with campus locations at the following addresses:
- Arnold - 11111 Telge Rd., Cypress 77429
- for the Cypress-Fairbanks Independent School District.
- B. The Project(s) consists of but is not limited to:  
Addition of Orchestra practice rooms, two art rooms, black box, stage storage at auditorium, replacement of auditorium A/V systems and controls and theatrical light fixtures, mechanical upgrades, and security enhancements.
- C. Project Schedule:
1. Substantial Completion date: July 26, 2026
  2. General phasing requirements refer to Part 3.1.B below.

##### 1.2 CONTRACTS AND USE OF SITE

- A. Contractor Use of Premises:
1. Confine operations at site to areas permitted by law, permits, and Contract Documents, or as required to maintain campus operations (as approved by Owner).
  2. Do not unreasonably encumber site with materials or equipment. Refer to Contractor lay-down areas indicated on plans. If not indicated on plans provided, Contractor to submit for approval proposed Contractor designated areas, including but not limited to: lay-down, staging, parking, restroom, trailer, dumpster, field office, etc.
  3. Assume full responsibility for protection and safekeeping of products stored on premises.
  4. Obtain and pay for use of additional storage or work areas as needed for operations.
  5. Contractor shall establish secured staging area for work and coordinate and provide for safe passage and exit from existing building areas during construction, in compliance with all applicable codes and requirements of Owner.
  6. During phased construction, Contractor shall provide maps of building to Owner for each phase, showing construction area and impact to other areas of the building.
  7. Contractor shall coordinate all construction activities with school district officials.
  8. Owner reserves the right to perform construction operations with its own forces or to employ separate contractors on portions of the Project. General Contractor shall coordinate with Owner-performed work in terms of providing site access, workspace, and storage space, cooperation of work forces, scheduling, and technical requirements.
  9. Noise Control: Contractor shall coordinate equipment locations and timing of work activities so as to avoid conflict with the building occupants and/or avoid interference with facility meetings, events, or other activities.
  10. Utilities. The contractor is to coordinate all utilities permanent and temporary and make arrangements for installation for any service easements once the Owner provides information that a blanket or final easement exists.

11. Project Fencing:
  - a. Upon mobilization, the contractor shall build a wire mesh fence (or other type) as directed by Owner, at least six (6) feet high as shown on site plan and/or discussed during the pre-construction meeting.
  - b. Site fencing shall include emergency service and trucking gated in locations shown on the site plan and/or discussed during the pre-construction meeting.
  - c. Contractor shall properly maintain fencing and gates until Substantial Completion and only remove with concurrence from the Owner.
  
- B. Owner Occupancy:
  1. Refer to AIA Document A201™-2017, as amended.
  
- C. Owner-Furnished/Owner-Installed Items:
  1. The Owner reserves the right to place and install equipment in construction areas of the building prior to Substantial Completion, provided that such occupancy does not interfere with completion of the Work. Such placing of equipment shall not constitute acceptance of the total Work. Contractor shall protect Owner's property.
  
- D. Owner-Furnished/Contractor-Installed Items:
  1. The Owner may provide items to the Contractor for installation in accordance with manufacturer's recommendation and instructions.
  2. The Owner will arrange and pay for delivery of Owner-furnished items in accordance with the Contractor's Construction Schedule and will inspect deliveries for damage.
  3. If Owner-furnished items are damaged, defective or missing, through no fault of the Contractor, the Owner will arrange for replacement.
  4. The Contractor is responsible for designating the delivery dates of Owner-furnished items in the Contractor's Construction Schedule and for receiving, unloading and handling Owner-furnished items at the site. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to elements, and to repair or replace items damaged as a result of his operations.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Refer to Specification Sections.

## **PART 3 - EXECUTION**

### **3.1 CONSTRUCTION SCHEDULE**

#### **A. GENERAL DESCRIPTION OF WORK TO BE PERFORMED UNDER THIS CONTRACT**

The Work to be performed under this contract shall commence on Notice to Proceed and shall be Substantially Complete as stipulated by AIA Document A101™-2017, as amended.

#### **B. GENERAL CONSTRUCTION PHASING REFERENCING CFISD NEEDS BELOW, SHALL BE INCORPORATED INTO THE CONTRACT, INCLUDING BUT NOT LIMITED TO:**

For the summer of 2025:

- Contractors may take over the building June 2, 2025.

- All athletic areas are to remain fully occupiable for the duration of the summer. Any work in the athletic areas will need to be coordinated with the campus. For gym work, only one gym can be under construction at any given time.
- All athletic, fine arts, dance, and cafeteria areas must be fully occupiable no later than July 15, 2025.
- The balance of the building shall be fully occupiable and turned back over to the district no later than July 27, 2025.
- Occupiable includes, but is not limited to, all life safety, MEP, architectural finishes in place, clean, and functioning as intended.
- Only work that can be removed and re-installed by these dates shall be performed during the summer.
- No partially complete work will be allowed after these dates unless approved in advance by the Owner.
- After these dates, all work shall be performed after hours, nights and weekends, while fully coordinating with the campus.

For the summer of 2026:

- Contractors may take over the building June 1, 2026.
- All athletic areas are to remain fully occupiable for the duration of the summer. Any work in the athletic areas will need to be coordinated with the campus. For gym work, only one gym can be under construction at any given time.
- All athletic, fine arts, dance, and cafeteria areas must be fully occupiable no later than July 15, 2026.
- The balance of the building shall be **SUBSTANTIALLY COMPLETE**, fully occupiable, and turned back over to the district no later than July 26, 2026.
- Occupiable includes, but is not limited to, all life safety, MEP, architectural finishes in place, clean, and functioning as intended.
- Only work that can be removed and re-installed by these dates shall be performed during the summer.
- No partially complete work will be allowed after these dates unless approved in advance by the Owner.
- After these dates, all work shall be performed after hours, nights and weekends, while fully coordinating with the campus.

#### **Furniture Campus**

This campus is receiving new student and administrative furniture via separate contract. However, General Contractor to comply with the following:

General Contractor to coordinate with CFISD and CFISD's vendor to provide interior and exterior clear unobstructed paths and access points for deliveries, product staging, product assembly, setup and disposal.

These areas must be available no later than July 15, 2025 and July 15, 2026 respectively.

- Delivery points will be accessible, clear and drivable by numerous eighteen wheeler trucks over a period of several weeks at middle and high schools.
- Staging/assembly areas include but are not limited to commons cafeteria, gyms, large group instruction, larger hallways (not impeding HCFMO fire egress), etcetera.
- Phased installation may include but not be limited to first setting up administration areas then academic classrooms, and finally ancillary support spaces last possibly spilling over from Summer into Thanksgiving week, Winter Break and Spring Break week if necessary
- As a guide, it is anticipated middle school furniture requires 2-3 weeks and high schools 3-4 weeks for phased installations.

**END OF SECTION**

## SECTION 01 11 23

### CODES, REGULATIONS AND STANDARDS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality Assurance
- B. References Standards
- C. Definitions
- D. Format and Specification Context Explanations
- E. Abbreviations
- F. Drawing Symbols
- G. General Requirements

##### 1.2 QUALITY ASSURANCE

- A. General:
  - 1. For products or Workmanship specified by a standard of an association, trade, or Federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code authorities having jurisdiction.
  - 2. The contractual relationship of the parties to the Contract should not be altered from the Contract Documents by mention or inference otherwise in any reference standard.
  - 3. Obtain copies of standards when required by Contract Documents.
  - 4. Maintain copy of standards at jobsite during submittals, planning, and progress of the specific Work for which the standards pertain, until the date of Substantial Completion.
  - 5. In the absence of specific instructions in the specifications, materials, products, equipment and their installation shall conform to the applicable codes, regulations and standards specified therein. When a conflict exists between the applicable code, regulation and standard and that specified, the more stringent code regulation or standard shall prevail, except as authorized by applicable authorities having jurisdiction.
- B. Industry Standards: Where compliance with two (2) or more industry standards or sets of requirements is specified and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into the Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer questions to the Architect for a decision before proceeding.
- C. Contractor's Option: Except for overlapping or conflicting requirements, where more than one (1) set of requirements are specified for a particular unit of Work, the option shall be Contractor's regardless of whether or not it is specifically indicated as such.
- D. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended to be the minimum for the Work to be performed or provided. Except as otherwise specifically indicated, the actual Work shall either comply exactly with the minimum (within specified

tolerances). In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.

- E. Specialists; Assignments: In certain instances, specification text requires (or implies) that specific Work is to be assigned to specialists. Such Work shall be accomplished by the specified specialist. These requirements should not be interpreted so as to conflict with applicable regulations, union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as “expert” for the indicated construction processes or operations. Notwithstanding any such designation, the final responsibility for fulfillment of all Contract requirements remains with the Contractor.

### 1.3 REFERENCE STANDARDS

- A. Dates of codes, regulations and standards specified shall be the latest date of issue of that code, regulation or standard prior to the date of issue of this Project Manual or Document, except as modified or otherwise directed by the applicable codes and their supplements and amendments adopted by the code authorities having jurisdiction.
  - 1. Date of Issue - The “date of issue” as it appears in the statement above, means the date which appears on the cover of the Project Manual or Document corresponding to the date of issue of the Contract Documents.
  - 2. Code Authorities: The “code authorities” as it appears in the statement above, means the International Building Code (IBC) with City of Houston Amendments, Harris County Regulations, and those authorities responsible for code enforcement.

### 1.4 DEFINITIONS

- A. General Explanation: A substantial amount of specification language consists of definitions for terms found in other Contract Documents, including those in the AIA A201 General Conditions of the Contract for Construction as amended, Supplementary Conditions, the Drawings, and the Specifications. Drawings must be recognized as being diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the Contract Documents are defined in the General Conditions, Supplementary Conditions, and in this Section. Definitions and explanations contained in this Section are not necessarily either complete or exclusive but are general for this Work to the extent that they are not stated more explicitly in another element of the Contract Documents. In the event of a conflict in definitions or explanations within the Contract Documents or whenever there is need of clarification or interpretation of definitions within or between the Contract Documents, notify the Architect immediately and proceed as directed. Except in cases where definitions are determined by code authorities having jurisdiction, the Architect’s interpretation of all definitions will take precedence.
- B. General Requirements: The provisions or requirements of Division 1 - Sections apply to entire Work of Contract and, where indicated, to other elements which are included in the Project.
- C. Special Conditions: Wherever the term “Special Conditions”, appears in the Contract Documents, it refers collectively to all requirements of the Owner in addition to the sections in Division 1, General Requirements, and to Articles contained in the General Conditions and Supplementary Conditions.
- D. Architect: Wherever the term “Architect” appears in the Contract Documents, it means PBK ARCHITECT Architects or their authorized representative(s).
- E. Bid, Competitive Sealed Proposal (CSP), Response, Offer, etc.: Wherever the term “Bid”, “Competitive Sealed Proposal (CSP)”, “Response”, “Offer”, “Proposal”, or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean

Competitive Sealed Proposal, which by definition allows the Owner to accept the “best value” for the school district based on factors other than cost in selecting the Contractor.

- F. Contractor, General Contractor, etc.: Wherever the term “Contractor”, “General Contractor”, “Prime Contractor”, “Bidder”, “Bidder/Vendor”, “Vendor”, “Installer”, “Integrator”, “Subcontractor”, “Respondent”, “Offeror”, or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall refer to the entity (person or firm) licensed and meeting all applicable regulations of the State of Texas and Department of Labor to perform the Work, or their authorized representative(s).
1. Responsibilities: To avoid any misunderstanding or lack of interpretation, the responsibility for performing the Work is totally that of the entity defined above, and the resolutions proposed in his shop drawings and related documentation shall be demonstrated throughout the Work and specified warranty period.
  2. In the event of a controversy involving the Contract Documents or interpretation of Project requirements, the decision of the Architect will take precedence.
- G. Consultant: Wherever the term “Consultant”, or any derivative thereof appears in the Contract Documents, it means the following:
1. Owner's Consultants:
    - a. Third Party Plan Reviewer: Winning Way
    - b. Materials Testing: Ninyo & Moore
    - c. Roof Inspection: Raba Kistner
    - d. Mechanical Testing and Balancing: EAB
    - e. Commissioning: EAB
  2. Architect's Consultants:
    - a. Civil Engineer: Brooks & Sparks
    - b. Structural Engineer: Kubala Engineers
    - c. MEP Engineer: LEAF Engineers
    - d. Landscape Consultant: Edgeland
    - e. Roofing Consultant: BEAM
    - f. Food Service Consultant: N/A
    - g. Asbestos Abatement Consultant: EFI Global, Inc.
    - h. Geotechnical Engineer: Raba Kistner
    - i. Traffic Engineer: LEAF Engineers
    - j. Acoustical Engineer: WJHW
- H. Indicated: Wherever the term “indicated”, or any derivative thereof appears in the Contract Documents, it means a cross-reference to graphic representations, notes, or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used in lieu of “indicated”, it is for the purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- I. Directed, Requested, Etc.: Where not otherwise explained, terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, “accepted”, and “permitted” or any derivative thereof appears in the Contract Documents, it means as “directed by the Architect”, “requested by the Architect”, and similar phrases with actions taken by the Architect. However, no meaning or otherwise shall be interpreted to extend the Architect’s responsibility into Contractor’s area of construction supervision.
- J. Approve: Wherever the term “Approve”, or any derivative thereof appears in the Contract Documents, it means only the Architect, or an individual designated by him as his representative, can approve or disapprove contract actions. Even if the specifications indicate that an individual other than the Architect, such as the “Engineer” or “Consultant” will approve or disapprove an

action, it is understood that only the Architect has this authority unless the individual is so designated by him in writing. Even when an individual is so designated, the Contractor may appeal the action to the Architect and the Architect's decision will be final. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibility to fulfill requirements of the Contract Documents.

- K. **Furnish:** Wherever the term "Furnish", or any derivative thereof appears in the Contract Documents, it means supply or deliver to Project site, ready for unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- L. **Install:** Wherever the term "Install", or any derivative thereof appears in the Contract Documents, it means performing the operations at the Project site, of unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- M. **Provide:** Wherever the term "Provide", or any derivative thereof appears in the Contract Documents, it means furnish and install at the Project site, complete and ready for intended use, as applicable in each instance.
- N. **Project, Site:** Wherever the term "Project", "Site", or similar such term appears in the Contract Documents, it means the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing Work as part of the Project. The extent of project or site is shown on the Drawings and may or may not be identical with description of land upon which Project is to be built.
- O. **District, School District, Owner, etc.:** Wherever the term "District", "School District", "Owner", "Cy-Fair ISD", "CFISD", or similar such term appears in the Contract Documents, it means Cypress-Fairbanks Independent School District, 11430 Perry Road, Houston, Texas 77064, (281) 897-4057, or its authorized representative(s).
- P. **Installer:** Wherever the term "Installer", or any derivative thereof appears in the Contract Documents, it means the entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for performance of a particular unit of Work at the Project, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.
- Q. **Specialist:** Wherever the term "Specialist", or any derivative thereof appears in the Contract Documents, it means an individual or firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of Workmen skilled in either (as applicable) manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing Work required by the Contract. Where the Contract Specification requires installation by a specialist, that term shall also be deemed to mean either the manufacturer of the item or firm who will perform the Work under the manufacturer's direct supervision.
- R. **Testing Laboratory:** Wherever the term "Testing Laboratory", or any derivative thereof appears in the Contract Documents, it means an independent entity engaged to perform specific inspections or tests of the Work, either at the Project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

## 1.5 FORMAT AND SPECIFICATION CONTEXT EXPLANATIONS

- A. **Underscoring:** Is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where underscoring is used.

- B. Capitalization: Except for manufacturer, product, or trademark names, capitalization is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where capitalization is used.
- C. Imperative language: Is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by the Contractor, or when so noted, by others.
- D. Section Numbering: Is used to facilitate cross-reference in Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in Contract Documents.
- E. Page Numbering: Pages are numbered independently for each section. The section number is shown preceded by the project number and followed by the page number at the bottom of each page, to facilitate the location of text. The project number is given to identify the project, for which specification was written, should the section become separated from the Project Manual.
- F. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include “prescriptive”, “open-generic descriptive”, “compliance with standards”, “performance”, or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.

## 1.6 ABBREVIATIONS

- A. The language of Specifications and other Contract Documents is of the abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual Work abbreviations of a self-explanatory nature have been included in texts. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates. A list of typical abbreviations includes but is not limited to the following trade associations and organizations. Refer to Drawings and other Contract Documents for other abbreviations.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Assn.
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
AGA	American Gas Association
AGC	Associated General Contractors of America
AHA	American Hardboard Association
AHGA	American Hotdip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron & Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	Air Conditioning & Refrigeration Institute
ASA	Acoustical Society of America



ASA	American Subcontractors Association
ASC	Adhesive & Sealant Council, Inc.
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Professional Engineers
ASAHC	American Society of Architectural Hardware Consultants
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASPI	American Wood Preserver's Institute
ASTM	ASTM International
AWI	Architectural WoodWork Institute
AWS	American Welding Society
BIA	Brick Institute of America
BRI	Building Research Institute
CRA	California Redwood Association
CLFMI	Chain Link Fence Manufacturers Institute
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DHI	Door and Hardware Institute
EPA	Environmental Protection Agency
FTI	Facing Tile Institute
FGMA	Flat Glass Marketing Association
GA	Gypsum Association
HPMA	Hardwood Plywood Manufacturers Association
IBC	International Building Code
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
JSMA	Joint Sealer Manufacturers Association
MFMA	Maple Flooring Manufacturers Association
ML/SFA	Metal Lath/Steel Framing Association
NAAMM	National Association of Architectural Metal Manufacturers
NAMM	National Association of Mirror Manufacturers
NBLP	National Bureau of Lathing & Plastering
NCPI	National Clay Pipe Institute
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Assn.
NESC	National Environmental Systems Contractors
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NHLA	National Hardwood Lumber Association
NOMMA	National Ornamental Metal Manufacturers Assn
NPVLA	National Paint, Varnish and Lacquer Assn.
NRMCA	National Ready Mixed Concrete Assn.
NRCA	National Roofing Contractors Association
NSPE	National Society of Professional Engineers
NWMA	National WoodWork Manufacturers Assn., Inc.
OSHA	Occupational Safety and Health Administration
PDCA	Painting and Decorating Contractors of America
PI	Perlite Institute, Inc.
PCA	Portland Cement Association
RFCI	Resilient Floor Covering Institute
RVFC	Rubber and Vinyl Floor Council
SBCCI	Southern Building Code Congress International, Inc.
SFPA	Southern Forest Products Association
SHLMA	Southern Hardwood Lumber Manufacturing Assn.
SDI	Steel Deck Institute

SDI	Steel Door Institute
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
TCA	Tile Council of America, Inc.
UBC	Uniform Building Code
UL	Underwriter's Laboratories, Inc.
VBI	Venetian Blind Institute
VFI	Vinyl Fabrics Institute
WCLIB	West Coast Lumber Inspection Bureau
WRCLA	Western Red Cedar Lumber Association
WWPA	Western Wood Products Association

## 1.7 DRAWING SYMBOLS

- A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols defined by "Architectural Graphic Standards", published by the American Institute of Architects (AIA) and John Wiley & Sons, Inc., latest edition. Refer instances of uncertainty to Architect for clarification before proceeding.
- B. Mechanical/Electrical Drawings: Graphic symbols used in Mechanical/Electrical Drawings are generally aligned with symbols recommended by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). Where appropriate, those symbols are supplemented by more specific symbols as recommended by other recognized technical organizations, including, but not limited to American Society of Mechanical Engineers (ASME), American Society of Professional Engineers (ASPE), Institute of Electrical and Electronic Engineers (IEEE) and similar organizations. Refer instances of uncertainty to Architect for clarification before proceeding.

## 1.8 GENERAL REQUIREMENTS

- A. Color, Texture, or Pattern Requirements:
1. When color, texture, or pattern is specified, the item, product, or material shall be furnished in the specified color, texture, or pattern, as applicable.
  2. When more than one (1) approved manufacturer is named in the Specifications, Contractor may select any of the approved manufacturers and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection.
  3. When the term "match existing", or any derivative thereof appears in the Contract Documents, it means that the sample must match the Owner's existing Work in every respect as to color, texture, and pattern, as applicable.
  4. When the term "match Architect's approved sample", or any derivative thereof appears in the Contract Documents, it means that the Architect has selected a sample which must be matched in every respect as to color, texture, and pattern, as applicable.
  5. When an item or product is specified of a manufacturer for which only one (1) color, texture, or pattern is available, and a color, texture, or pattern other than that one is specified, Contractor shall bring it to the attention of the Architect for a decision prior to proceeding with the Work. Do not proceed with the Work until Architect has approved the color, texture, and pattern, as applicable.
  6. When an item or product is specified of a manufacturer for which no color, texture, or pattern is specified, and colors, textures, and patterns are available, Contractor shall bring it to the attention of the Architect and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection. Do not proceed with the Work until Architect has selected and approved the color, texture, and pattern, as applicable.

7. When due to the nature of the item, product, or material, i.e., face brick, tile pavers, natural stone, etc, Contractor shall submit sample or samples which exhibits the full range of characteristics (colors, i.e. lights and darks, as well as textures, and patterns) for which the item, product, or material is available. The Architect will select the color, texture, and pattern, as applicable, from those available and request a sample panel exhibiting the approved characteristics. The approved color range, texture, and pattern, as applicable will then become the standard for which all Work on the project will be judged. Architect will be final judge as to having performed Work in conformance with approved characteristics.
  8. Under no circumstances are colors, textures, patterns, or any other characteristics for which an item, product, or material are available to be selected by anyone other than the Architect or Owner.
  9. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.
- B. Continuity of Building Envelope, Full Height Partitions, and Fire Rated Construction:
1. Continuity of Building Envelope:
    - a. All materials such as exterior sheathing, membrane flashings, vapor barriers, insulations, dampproofing, waterproofing, roofing, flashings, etc. and all penetrations, holes, gaps, joints, and openings through such materials shall be sealed to ensure continuity of building envelope, whether indicated or not to eliminate moisture penetration.
    - b. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
  2. Full Height Partitions:
    - a. All full height partitions shall be from floor to bottom of deck structure and shall be made to fit around steel joists, beams, etc., whether indicated or not.
    - b. Seal joints at top of partitions, in flutes of steel deck, and around structural elements with a compressible filler and/or sealant to accommodate movement due to expansion, contraction, and deflection, whether indicated or not. Treat seals in joints of fire rated partitions as specified below for fire rated construction, whether indicated or not.
    - c. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
  3. Fire Rated Construction:
    - a. All seals in fire rated construction, whether at top, bottom, or penetrations through fire rated construction, shall be made with firestopping and firesafing materials to maintain fire rating integrity of construction and satisfy authorities having jurisdiction, whether indicated or not.
    - b. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
- C. Plumbing Line Protection:
1. Placing or washing materials, including, but not limited to the following, down any plumbing line or fixture is strictly forbidden.
    - a. Concrete, cement, sludge, mortar, grout, plaster, or any other cementitious material
    - b. Paint, paint thinner, turpentine, kerosene, gasoline, oil, or any other petroleum or hazardous products.
  2. Cleaning painting equipment, including brushes in new or existing plumbing fixtures is strictly prohibited.
  3. Contractor shall certify that all affected plumbing lines and fixtures are clean, free flowing and running. Plumbing lines and fixtures damaged as a result of any of the above shall be repaired or replaced at no expense to Owner. Contractor shall bear responsibility and all costs of fines, penalties, and legal fees attributed to violations as levied by authorities having jurisdiction.

- D. Support from Structure: Ducts, pipes, conduits, equipment, and other items indicated to be supported from the structure shall be accomplished using approved hangwires, hangers, or devices of type, size and material recommended to suit the application and installed in accordance with recommendations of the hanger or device manufacturer, Architect and/or Structural Engineer, or code authorities having jurisdiction, whichever is the more stringent requirement. Nothing shall be hung from the structure unless directed to do so by the Architect and/or Structural Engineer.
- E. Ducts, Pipes, Conduits, and Wires: Shall be concealed in walls, chases, and enclosed areas out of view, unless specifically indicated as exposed or where exposure is required for proper function of item, such as air registers, air returns, louvers, grilles, vents, thermostats, electrical receptacles, telephone/data terminals and jacks, light switches, etc. Refer instances of uncertainty to Architect for clarification before proceeding.
- F. Fasteners:
1. Unless specifically indicated or directed otherwise, all fasteners in Work exposed to view, shall be concealed in the finished Work.
  2. No fasteners shall show through or telegraph through exposed face of finished Work and all finished surfaces shall be free of all evidence of the existence of fasteners.
  3. Fasteners shall be spaced to accurately and rigidly secure Work in place.
  4. If not shown or otherwise required or recommended by manufacturer, standard, or code authorities having jurisdiction, fastener spacing shall not exceed 12 inches on center.
  5. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.
- G. Exposed Metal Work:
1. Unless specifically indicated or directed otherwise, all exposed metal Work shall be flat with all surfaces free of distortions, oil canning, waves, dents, scratches, weld marks, and other surface defects detrimental to good appearance or function.
  2. All steel exposed to exterior shall be hot-dip galvanized, phosphate treated for paint retention and shop prime painted.
  3. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 - EXECUTION**

Not Used

**END OF SECTION**

## SECTION 01 11 26

### OWNER/ARCHITECT PROVIDED DOCUMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 COPIES OF SUPPLEMENTARY CONTRACT DOCUMENTS

- A. The Owner and Architect have included the following Supplementary Contract Documents for the Offerors information. The Owner and Architect **do not** guarantee the accuracy, completeness, or suitability of this information, and the Offerors should verify the existing conditions prior to the Proposal date.
1. Geotechnical Investigation Report – Refer to Section 02 32 00
    1. Entitled: Arnold Middle School Additions and Renovation
    2. Prepared for: PBK Architects, Inc
    3. Prepared by: Raba Kistner
    4. Dated: January 24, 2025
  2. Geotechnical Investigation Report – Refer to Section 02 32 00
    - a. Entitled: Arnold Middle School Additions and Renovations
    - b. Prepared For: PBK Architects, Inc.
    - c. Prepared by: EFI Global, Inc.
    - d. Dated: February 13, 2025
- B. The boring log from the above-mentioned soils report is included in Section 02 32 00, Geotechnical Investigation.
- C. Any of the above documents bound in the drawing or specifications are included for reference purposes only.
- D. Neither Architect nor Owner guarantees their contents as to accuracy, completeness, or suitability.
- E. Copies may be examined at the Architect's office.

#### PART 2 - PRODUCTS

Not Used

#### PART 3 - EXECUTION

Not Used

**END OF SECTION**

2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077  
Tel: 832-518-5145

**QAQC CD Bid Version  
Interior and Exterior Renovations**

**Cypress-Fairbanks  
Independent School District**

**Arnold Middle School  
11111 Telge Road  
Cypress, Texas 77429**

**Asbestos Survey  
For Proposed Renovations of the  
Arnold Middle School Campus**

**Prepared For:  
PBK Architects, Inc.  
11 Greenway Plaza 22nd Floor  
Houston, Texas 77046  
c/o**

**Cypress-Fairbanks Independent School District  
11430 Perry Road  
Cypress, Texas 77429**

**February 13, 2025**

**EFI Project: 029.07189**



2000 Dairy Ashford, Suite 600  
Houston, Texas 77077  
(832) 518/5145

Report No. 029.07189  
February 13, 2025

PBK Architects, Inc.  
11 Greenway Plaza 22nd Floor  
Houston, Texas 77046

Attention: Ms. Sarah Stolting

email: Sarah.Stolting@pbk.com

**RE: Limited Asbestos Survey  
Arnold Middle School  
11111 Telge Road  
Cypress, Texas 77429**

EFI Global, Inc. (EFI) was retained by PBK Architects, Inc., (PBK), on behalf of Cypress-Fairbanks Independent School District (CFISD), to provide asbestos consulting services for the proposed renovations and demolition at the Arnold Middle School campus located at 11111 Telge Road in Cypress, Texas. The first phase of EFI's work was to review available asbestos history/data, conduct an asbestos survey of suspect Asbestos-Containing Building Materials (ACBM) and provide a report detailing our findings. The primary purpose of the survey is to locate, sample and analyze typical suspect friable and non-friable asbestos-containing materials. Mr. Kenneth Capps (Texas Department of Health License No. 10-5850) and Mr. Sam Huff (Texas Department of Health License No. 10-5902) of EFI conducted the initial field survey on December 5-12, 2024, with additional testing conducted on January 27, 2025. Work on this project was performed in general accordance with EFI Proposal No. 98410-24-0900 dated October 16, 2024, as authorized by Mr. Brandon Ross of PBK on October 24, 2024.

We appreciate the opportunity to provide these services to CFISD and PBK. If you have any questions about this asbestos survey report, or, if we can be of further assistance, please contact us at (832) 518-5145.

Sincerely,  
EFI Global

A blue ink signature of Sam Huff, appearing as a stylized cursive "SH".

Sam Huff  
Staff Professional  
(TDSHS # 10-5902)

A blue ink signature of Kenneth Capps, appearing as a stylized cursive "KC".

Kenneth Capps  
Project Manager  
(TDSHS # 10-5850)

(Z:\2024\CFISD\Arnold Middle School\Survey Info\029.07189 - Arnold Middle School Asbestos Rpt ACM)

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## INTRODUCTION

EFI was retained by PBK, on behalf of CFISD to provide asbestos consulting services for the proposed renovations and demolition at the Arnold Middle School campus located at 11111 Telge Road in Cypress, Texas. The first phase of EFI's work was to review available asbestos history documents for the subject facility, conduct an asbestos survey of suspect Asbestos-Containing Building Materials (ACBM) and provide a report detailing our findings. The following report details the sampling of multiple suspect building components that may be impacted by the proposed renovations and demolition for the subject property.

### Purpose and Scope of Work

The purpose of this project was to collect and analyze bulk samples of suspect ACBM at the campus. For the proposed demolition, EFI's sampling activities were generally limited to construction finishes impacted by the planned demolition, as noted by PBK. The following generalizations describe the proposed work:

- **Architecture:** Replace paint booth to meet district standards; replace educational casework in all classrooms (excluding science labs); replace ceiling with new acoustical lay-in ceiling tile and grid throughout facility; replace vinyl composite tile (VCT) and base throughout facility; replace science/lab classroom casework; renovate cafeteria; renovate Athletic and PE locker rooms areas; strip down and refinish floor in auxiliary gym; strip down and refinish floor in competition gym; add 1,000sf total to orchestra; provide new/additional acoustical wall treatments at band, choir, and orchestra; paint all previously painted interior surfaces. Repair/patch walls prior to painting; renovate corridor to provide new durable surfaces throughout; provide outside storage for football and track equipment; provide restrooms near performance gym; add acoustical treatment at Theater Arts 918; Art 922 – replace millwork; renovate orchestra room to district standards.
- **Athletics/Activities:** Replace existing epoxy floor finish in locker rooms; provide retractable bleachers.
- **Civil:** Replace main sanitary sewer line outside of building; remove and replace pavement joint sealant.
- **Electrical:** Replace existing switchgear; provide generator backed power for all racks in all telecommunications rooms; replace interior lights with LED; provide interior lighting controls; update cafeteria stage lighting, sound, A/V equipment and drapery packages; replace competition gym sound system; replace practice gym sound system.
- **Life Safety & Security:** Replace fire alarm; provide new marquee sign located at front entry per district standards.
- **Mechanical:** Replace piping insulation and clean interior of roof-mounted air handling units, including coils, drains pans, and drain line; provide sub-metering for kitchen electrical, cooling/heating and water usages; add dedicated HVAC unit to secondary telecommunications rooms (IDF); Replace dust collector; replace existing sellers boiler; replace HVAC controls.
- **Plumbing:** Repair gas piping on roof. Remove surface rust and paint. Replace all gas valves on roof; replace problem site sanitary at front of building; separate irrigation meter from existing water meter.

- **Technology:** Replace all existing data cables to Cat 6A
- **Security items:** Additional card readers on exterior doors; additional lockdown buttons; harden main front desk; enhanced video intercoms, exterior window, and door numbering; impact resistant glass on doors and high traffic areas; upgrade classroom and exterior door hardware.

The Main Building and additions were included as part of the survey process. Select areas or buildings were excluded, including but not limited to: any maintenance sheds, Portable Buildings, or Sports Fields. Select building materials and areas throughout the campus were excluded from the EFI survey process since renovations were not described as impacting multiple areas and building components. Additional investigations may be requested by CFISD, or the Architect and reporting will be issued under separate cover.

EFI's scope was limited to and included visual observation of accessible building components that would have the potential to be impacted by the proposed renovations; architectural, mechanical, electrical and security upgrades; and excluded underground utilities, underground piping, electrical panels, enclosed/encased wall cavities and a multitude of other building components as referenced in other sections of this report. The scope of services for this survey included performance of the following tasks:

- Review available proposed renovation scope of work and reference previous asbestos historical documentation;
- Collect samples of suspect ACBMs that would be impacted by the proposed renovations and perform laboratory analyses;
- Prepare a report discussing our findings, and give recommendations for dealing with asbestos-related hazards prior to renovations and provide generalized assessment of physical conditions; and
- Submit approximate locations and general descriptions of all identified and/or presumed ACBMs.

### **Report Organization**

This report is divided into sections which discuss our field survey, laboratory analyses, hazard assessments, regulatory overview, and abatement recommendations. Supporting documentation follows the text.

### **FIELD SURVEY**

Mr. Kenneth Capps (Texas Department of Health License No. 10-5850) and Mr. Sam Huff (Texas Department of Health License No. 10-5902) of EFI conducted the initial field survey on December 5-12, 2024, with additional testing conducted on January 27, 2025, whereas accessible building materials/components were collected for laboratory analysis. This survey activity was performed to confirm the presence of ACBM in all “accessible” building components impacted by the renovations process. The samples for each homogeneous material zone were collected in sufficient numbers to comply with U.S. Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), and DSHS protocols.

## Observations

The Arnold Middle School Campus is located at 11111 Telge Road in Cypress, Texas. Based upon available information, the following structures on the site are described as:

- **Main Building:** The school campus, constructed circa 1955, has had renovation completed in 2003 and 2010 with building additions being completed in 1956, 1962, 1973, 1977, 1984, and 2010. The main building is a one-story brick veneer, slab on grade structure consisting of structural steel framing with spray-applied fireproofing (on columns, select beams, including overspray on adjacent surfaces), corrugated decking and select applications of bar-joint framing insulated with fiberglass batting. There are plaster exterior eaves and select gypsum ceiling and/or wallboard with joint compound throughout. The majority of campus has a lay-in metal grid ceiling system throughout most common areas and classrooms. There is ceramic and terrazzo flooring in the corridors, ceramic flooring in the restrooms, carpeting and vinyl flooring in most classrooms and miscellaneous areas, the locker rooms and natatorium have epoxy flooring, and the gymnasiums have wood flooring.
- The mechanical systems include shared Central Plant with Cy-Fair High School and a smaller plant with two boilers system supplying air handling rooms/units with chilled and heating water mixed piping loop. The air handlers supply conditioned air via ductwork to multiple diffuser vents. Select plenum areas have heating water supplying coil units to condition spaces during cooler periods. The plumbing systems include insulated domestic water piping (cold and hot), sewer, venting and roof drain systems.
- Roofing materials were not tested as these materials are not currently scheduled to be impacted/removed during renovation activities. Roofing materials are suspect ACM until proven otherwise (destructive sampling techniques will be required for the testing).

## Sampling

The scope of EFI's sampling included sampling of suspect building components impacted by the proposed demolition. Suspect building components were grouped into homogeneous materials. A homogeneous material is described as any suspect building component that is similar in color, texture, composition, etc. and was installed around the same timeline. The materials were given classification designations to distinguish between different materials zones.

As part of the December 2024 and January 2025 survey process, multiple Homogeneous Materials (HA) were documented and sampled from the facility structures. One hundred eighty-one (181) bulk samples were collected as part of the survey. Typical building materials that were collected and analyzed include but were not limited to:

<b>Sample Summary Table for Arnold Middle School</b>		
<b>HA#</b>	<b>Sample Description</b>	<b>Laboratory Result</b>
<b>01</b>	<b>Brown Vinyl Floor Tile with Black Mastic – 1957 Addition</b>	<b>2% Chrysotile &amp; 5% Chrysotile</b>
02	Brown/Yellow Carpet Mastic – 1964 Addition	Non-asbestos
03	Yellow Carpet Mastic – 1980 Addition	Non-asbestos
04	6"x4" Gray Vinyl Floor Tile with Tan Glue and Float – 1980 Addition	Non-asbestos
05	Epoxy Floor – 1980 Addition	Non-asbestos
06	12" White and Gray Vinyl Floor Tile with Yellow Mastic – 1980 Addition	Non-Asbestos
<b>07</b>	<b>Residual Black Mastic – 1980 Addition</b>	<b>4% Chrysotile</b>

<b>08</b>	<b>“Shiny” Gray/Black Sink Undercoating – 1980 Addition</b>	<b>2% Chrysotile</b>
09	Black Sink Undercoating – 1968 Addition	Non-asbestos
10	12” White and Gray Vinyl Floor Tile with Brown/Yellow Mastic – 1968 Addition	Non-Asbestos
11	Carpet Pad and Glue with Yellow Mastic – 1968 Addition	Non-Asbestos
12	Carpet Pad and Glue – 1964 Addition	Non-Asbestos
13	12”x12” Beige and Gray Vinyl Floor Tile with Yellow Mastic on Float – 1964 Addition	Non-Asbestos
14	Gray Sink Undercoating – 1964 Addition	Non-Asbestos
<b>15</b>	<b>Residual Black Floor Mastic – 1955 &amp; 1964 Building</b>	<b>5% Chrysotile</b>
<b>16</b>	<b>Residual Soft Texture on Concrete Deck Panel – 1957 Addition</b>	<b>7% Chrysotile</b>
<b>17</b>	<b>Black Mastic on Pipe Insulation – Above Lockers Outside Room 115</b>	<b>5% Chrysotile</b>
<b>18</b>	<b>Window Glazing Putty on Windows – 1957 Addition Abandoned in Wall Cavities</b>	<b>3% Chrysotile</b>
19	Residual Black Chalk Board Mastic – Mechanical Room 1957 Addition	Non-Asbestos
<b>20</b>	<b>Joint Filler – 1955 Building</b>	<b>3% Chrysotile</b>
21	Brown Stick Pin Mastic on Concrete Deck Panel - 1955 & 1957 Addition	Non-Asbestos
22	2’x2’ Pinhole Ceiling Panel	Non-Asbestos
<b>23</b>	<b>Pink Sink Undercoating – 1955 Building</b>	<b>2% Chrysotile</b>
<b>24</b>	<b>Damp Proofing on Clay Block with Copper Flashing – 1955 Building</b>	<b>5% Chrysotile</b>
25	Gypsum Board Ceiling with Joint Compound – Girls PE Locker	Non-Asbestos
26	Epoxy Flooring – Girls PE Locker	Non-Asbestos
27	Domestic Hot Water Pipe Insulation with White Mastic – Girls PE Locker Room Coaches Office	Non-Asbestos
28	Chilled Water Pipe Insulation with White Mastic	Non-Asbestos
29	Heating Water Pipe Insulation with White Mastic	Non-Asbestos
30	Through Wall Flashing with Black Mastic – 2009 Addition	Non-Asbestos
31	Chilled Water Pipe Insulation with Black Adhesive and White Mastic – 2009 Building Addition	Non-Asbestos
32	Heating Water Pipe Insulation with Black Adhesive on Runs – 2009 Addition	Non-Asbestos
33	Boiler Rope Gasket – Boiler Room	Non-Asbestos
34	Boiler Tank Insulation – Boiler Room	Non-Asbestos
35	Gaskets at Flange – Boiler Room	Non-Asbestos
36	Heating Water Pipe Insulation with White Mastic – Boiler Room	Non-Asbestos
37	Black Sealant on Heater with Pipe Insulation – Outside Boiler Room	Non-Asbestos
38	Black Damp Proofing on AMU – Boys Locker Room 1868 Addition	Non-Asbestos
<b>39</b>	<b>Transite Panel Above Door – Boys Locker Room Entrance 1968 Addition</b>	<b>40% Chrysotile</b>
40	Epoxy Floor – Boys Locker Room	Non-Asbestos
41	Gypsum Board with Joint Compound – Boys Locker Room	Non-Asbestos
42	Domestic Hot Water Pipe Insulation with White Mastic – Boys Locker Room	Non-Asbestos
43	Tan Fireproofing – 1965 Addition	Non-Asbestos
44	Carpet Pad and Glue – 2009 Addition	Non-Asbestos
45	Cove Base Mastic – 2009 Addition	Non-Asbestos
46	CMU Block Filler – 2009 Addition	Non-Asbestos

47	Gypsum Wall Board with Joint Compound – 2009 Addition	Non-Asbestos
48	Tan Fireproofing – 2009 Addition	Non-Asbestos
49	Damp Proofing and Flashing on CMU – 2009 Addition	Non-Asbestos
<b>50</b>	<b>Transite Panel at Original Wall – Room H306, 1955 Building</b>	<b>40% Chrysotile</b>
<b>51</b>	<b>Damp Proofing on CMU Block with Flashing – Corridor outside Cafeteria, 1977/1980 Addition</b>	<b>7% Chrysotile</b>
52	Gray Fireproofing – Corridor outside Cafeteria, 1977/1980 Addition	Non-Asbestos
<b>53</b>	<b>Damp Proofing on CMU Block – Band/Rehearsal Corridor, 1968 Addition</b>	<b>7% Chrysotile</b>
54	“Fluffy” Fireproofing – 1964 Addition	Non-Asbestos
55	Mudded Fitting Debris on Ceiling – 1964 Addition	Non-Asbestos
<b>56</b>	<b>Black Damp Proofing on CMU Block and Mortar – Room E05 Mechanical Room, 1965 Addition</b>	<b>7% Chrysotile</b>
<b>57</b>	<b>Black Damp Proofing on CMU Block and Mortar – Room E410, 1968 Addition</b>	<b>7% Chrysotile</b>
<b>58</b>	<b>Plaster Joint Filler and Texture – Outside Room 802, 1957 Addition</b>	<b>7% Chrysotile</b>
<b>59</b>	<b>White Over Spray on Concrete Decking – Boys Restroom, 1957 Addition</b>	<b>7% Chrysotile</b>
60	2’x2’ Gypsum ceiling panels – Kitchen Area	Non-Asbestos
61	Gray sealant on shop dust collector	Non-Asbestos
62	Fireproofing – 2012 Gymnasium addition	Non-Asbestos
63	Damp proofing on CMU block with pink foam – 2012 Gymnasium addition	Non-Asbestos
64	Damp proofing on exterior gypsum sheathing – 2012 Gymnasium addition	Non-Asbestos
65	Plaster soffit – 2012 Gymnasium addition	Non-Asbestos
66	Exterior door frame caulking	Non-Asbestos
67	Felt paper behind tectum wall panels – old gymnasium	Non-Asbestos
68	Window glazing putty around old gymnasium door/windows	Non-Asbestos
69	Caulking around tectum wall panels – old gymnasium	Non-Asbestos

HA# = Homogeneous Area Number

The samples for each homogeneous material listed above were generally collected in sufficient numbers to comply with U.S. Environmental Protection Agency (EPA), Texas Department of State Health Services (TDSHS), and Asbestos Hazard Emergency Response Act (AHERA) survey sampling protocols.

Appropriate chain-of-custody procedures were initiated at the site for all samples. Bulk samples were collected in a manner that reduced the potential for fiber release and exposure by using wet sampling methods and personal protective equipment, if necessary. Bulk samples collected during the survey were deposited in secure containers for transport to an independent third-party laboratory, Micro Analytical Services, Inc. (MAS), in Houston, Texas.

#### **LABORATORY ANALYSIS**

Bulk samples collected during the survey were deposited in secure containers for transport to the MAS laboratory in Houston, Texas. MAS is a successful participant in the National Voluntary Laboratory Accreditation Program (NVLAP Lab # 200618-0) and licensed by Texas Department of State Health Services (TDSHS License # 30-0341).

## Analytical Procedure

All sampled materials were initially analyzed using Polarized Light Microscopy (PLM) coupled with dispersion staining as detailed in the EPA's "Method for the Determination of Asbestos in Bulk Building Materials" (EPA/600/R-93/116). Percentages for the samples were determined by visual area estimation.

## Bulk Sample Results

The results of the laboratory analyses are presented in Appendix A1 – Laboratory Report, and Homogeneous Material Description Forms. Based upon the laboratory results, the following information was obtained:

- **The 9"x9" brown vinyl floor tile with black mastic was found to contain 2% chrysotile asbestos in the floor tile and 5% chrysotile asbestos in the black mastic. (Approximately 100+ square feet)**
- **The residual black floor mastic located in the storage room A918 of the 1980 building addition was found to contain 4% chrysotile asbestos. (Approximately 50+ square feet, may be under millwork)**
- **The residual black floor mastic located in room G236 of the 1955 building and in the H01E Mechanical room of the 1964 building was found to contain 5% chrysotile asbestos. (Approximately 35+ square feet)**
- **The residual soft texture located between concrete deck panels and above original crown molding in the 1957 building addition was found to contain 7% chrysotile asbestos.**
- **The black mastic on pipe insulation located above lockers outside room 115 was found to contain 5% chrysotile asbestos. (Approximately 60+ linear feet)**
- **The window glazing putty on abandoned windows in the 1957 building addition was found to contain 3% chrysotile asbestos. (Quantity unknow, hidden in walls)**
- **The plaster joint filler applied to the concrete deck panels in the 1955 building was found to contain 3% chrysotile asbestos.**
- **The pink sink undercoating applied underneath the sinks in the 1955 building was found to contain 2% chrysotile asbestos. (Approximately 2 Units)**
- **The transite panel located above the entrance door to the boy's locker room in the 1968 building addition and the transite panels located above the ceilings at the original walls of the 1955 building were found to contain 40% chrysotile asbestos. (Approximately 60+ panels)**
- **The damp proofing on CMU block with flashing located in the corridor outside the cafeteria in the 1977/1980 building addition was found to contain 7% chrysotile asbestos.**
- **The damp proofing on CMU block located in the corridor outside the band/rehearsal room in the 1964 building addition was found to contain 7% chrysotile asbestos.**
- **The black damp proofing on CMU block and mortar in room E05 (mechanical room) in the 1965 building addition and room E410 in the 1968 building addition were found to contain 7% chrysotile asbestos.**
- **The plaster joint filler with texture located in the 1957 building addition was found to contain 7% chrysotile asbestos.**

- The white over spray on concrete decking in the boy's restroom in the 1957 building addition was found to contain 7% chrysotile asbestos. (Approximately 20+ square feet)
- [See Known Asbestos Contain Building Materials below for additional information]
- [See Assumed ACBM Section below for additional information]

Mastics, adhesives, floor tile and other resinously bound materials, when analyzed by the EPA method, may yield false negative results because of limitations in separating closely bound fibers and in detecting fibers of small length and diameter. When a definitive result is required, EFI recommends utilizing alternative methods of identification, including transmission electron microscopy (TEM).

### **Identified Asbestos Containing Building Materials**

Previous inspections have been conducted throughout the years at Arnold Middle School and many types of materials have been identified as asbestos containing materials. During our inspection, known asbestos contain building materials were noted to be impacted by the current path of demolition and construction. Below is a chart of materials and locations of known asbestos containing building materials.

<b>Arnold Middle School Identified Asbestos Containing Materials</b>			
<b>Material Type</b>	<b>Material Location</b>	<b>Material Classification</b>	<b>Material Assessment</b>
<b>Sink with Pink Undercoating. ACM 5%</b>	<b>Science Break and Classrooms</b>	<b>Category II Non-friable Misc.</b>	<b>Good Condition with potential for damage</b>
<b>Chilled water piping with mastic coating fiberglass</b>	<b>West Mechanical Room by Culinary</b>	<b>Category II Non-friable Misc.</b>	<b>Good condition with potential for damage</b>
<b>Window Wall</b>	<b>Encase West Facade</b>	<b>Presumed</b>	<b>ACM Archives</b>
<b>VCT Floor Tile 12" White and Gray Types with Yellow Mastic</b>	<b>Multiple areas Main Building</b>	<b>Category I Non-friable Misc. Most Abated</b>	<b>May be residual old tile under wall plates, fixed millwork</b>

### **Assumed ACBM Section, Previous History Findings and Materials Not Sampled**

As a result of our limited survey, select building components (or areas) were excluded from the survey process since the materials were either a) not identified to be disturbed by the proposed renovations, or b) inaccessible without substantial demolition access. Other building materials are encased, enclosed or deemed inaccessible without destructive sampling techniques.

In accordance with our proposal, the below listed material(s) were left intact and are, consequently, assumed to contain asbestos until proven otherwise:

- **Portable buildings, if any, were excluded from the EFI survey process. All building materials of the portable buildings are suspect ACBM until proven otherwise. Should the Portable buildings be planned for demolition or renovation an asbestos survey will be required.**
- **Previous abatement vinyl flooring and/or black floor mastic has been conducted through out the campus over the years, if any vinyl flooring and/or black mastic is discovered under millwork, wall plates or fix object removed during demolition, the flooring is presumed to be ACBM until proven otherwise.**

- **Underground utilities and/or piping were not accessible at the time of the survey. Underground piping may contain a mastic coating/wrap, or the piping may be constructed of fiber cementitious (Transite) type material. Should any piping be discovered during excavation, the piping coating/wrap should be assumed asbestos or if the pipe is a cementitious type of material.**
- **Duct insulation mastics, roof drainpipe insulation and mastics, chilled and heating water pipe insulation and mastics throughout the campus plenum areas and mechanical rooms unless specifically shown in the mechanical drawings are not in the current path of construction. Should the scope change and the insulation need to be removed, the duct/pipe insulation is suspect ACBM until proven otherwise.**
- **Chalkboards/Markerboards were observed to be mechanically attached. In some cases, it is possible that the chalkboard/markerboard may be adhered to the wall, the spot sealant applied behind the unit is suspect ACBM until proven otherwise.**
- **The mirrors were observed to be mechanically attached in the restrooms. Should any mirror be found to be adhered to the wall with mastic adhesive the mastic is suspect ACBM until proven otherwise.**
- **Gymnasium wood flooring may contain vapor barrier felts and mastic. The vapor barrier felts, and mastic located under the wood flooring is suspect ACBM until proven otherwise.**
- **Fire doors may have an internal asbestos sheet or packing and are suspect ACBM until proven otherwise.**

## HAZARD ASSESSMENTS

Asbestos is an airborne hazard. A hazard assessment refers to the process by which a material's potential to release fibers into the air is evaluated. Fibers may be released spontaneously as part of a materials aging process or when acted upon by other factors such as air movement, vibration, impact, renovations or localized deterioration. Assessing a material's potential for fiber release, and hence its associated hazard risk, is accomplished by evaluating these and other factors.

### Hazard Assessment Ratings

In accordance with AHERA regulations, any material identified as an ACM that exhibits damage should be considered a hazard to anyone in the area. Typically, damage is classified as minor or extensive. Minor damage is characterized by small cuts, tears, scuffs, small openings, or other limited disturbance to ACMs. Areas with minor damage represent varying degrees of hazards from low to high depending on:

- the nature of the damage;
- proximity to disturbers, such as air streams;
- location with respect to building occupants;
- activity in the immediate area; and
- frequency of maintenance in the area.

The recommended action for addressing asbestos-related hazards depends upon the degree of hazard. For example:

- A "**low**" assessment describes a situation in which the material is in good condition and has a low potential for disturbance, damage, or deterioration. In this situation, Operations & Maintenance (O&M) in the AHERA Asbestos Management Plan usually all that is needed.



## Material Assessments

As a result of our survey, the presence of asbestos was documented in the following building materials and Assumed ACM section. A general hazard assessment for the ACM is presented below.

- \* The **damp proofing coatings on CMU block with flashing** is considered a Category II non-friable ACM and in its current condition the material presents a “**low**” hazard.
- \* The **transite panels** are classified as a category II non-friable ACM and, if left intact, currently present a “**low**” hazard. Any disturbance of the material may present of “**high**” hazard if damaged (i.e. fire sprinkler installation and/or conduit/piping or duct installation).
- \* The **9”x9” vinyl floor tile and/ or black floor mastic** is considered Category I non-friable ACM. In its current condition the material presents a “**low**” hazard.
- \* The **window glazing putty** on abandoned windows in the 1950’s buildings addition is considered a category II non-friable ACM and if left intact, currently presents a “**low**” hazard. Any disturbance of the material may present of “**high**” hazard if the material is damaged or disturbed.
- \* The **pink and “shiny” gray/black sink undercoating** in the is classified as a category II non-friable ACM and if left intact, currently present a “low” hazard.
- \* The **soft texture** on concrete deck panel in the 1957 building addition is classified as RACM – Friable and presents a “**low**” hazard, if left intact. Any disturbance of the material may present of “**high**” hazard if damaged (i.e. fire sprinkler installation, new ceiling installation, new conduit/piping or duct installation).
- \* The **black mastic on pipe insulation** above the lockers classified as a category II non-friable ACM and if left intact, currently presents a “low” hazard.
- \* The precast concrete deck panel **plaster joint filler** throughout the 1955 and 1957 building is classified as RACM – Friable and presents a “**low**” hazard, if left intact. Any disturbance of the material may present of “**high**” hazard if damaged (i.e. fire sprinkler installation, new ceiling installation, new conduit/piping or duct installation).
- \* The **white over spray on concrete decking** in the boys’ and girls’ restrooms in the 1957 building addition is classified as RACM – Friable and presents a “**low**” hazard, if left intact. Any disturbance of the material may present of “**high**” hazard if damaged (i.e. fire sprinkler installation, new ceiling installation, new conduit/piping or duct installation).
- \* The Assumed ACM at the facility currently presents a **low** hazard. If any assumed components are to be impacted by renovations, the suspect material(s) should be sampled prior to disturbance and, if found to contain asbestos in concentrations greater than one percent, abated in accordance with applicable regulations.

## REGULATORY OVERVIEW

The EPA - NESHAP regulations (National Emissions Standard for Hazardous Air Pollutants - 40 CFR Part 61, Subpart M), require that all Regulated Asbestos-Containing Materials (RACM) be removed from a facility being demolished or renovated prior to any activity that would disturb the material. RACM is defined as (a) friable ACM, (b) Category I non-friable ACM that has become friable, (c) Category I non-friable ACM that will be or has been subject to sanding, grinding, or abating, or (d) Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material during the course of the renovations. Under current EPA AHERA regulations, the Asbestos Management Plan for the school facility requires updating to reflect the findings of any inspection process. EFI will forward the survey report to the CFISD Maintenance Department for inclusion into the AHERA Asbestos Management Plan.

## ABATEMENT RECOMMENDATIONS

Based upon our understanding that Arnold Middle School is proposed for renovations in select areas, we make the following recommendations:

- \* **Renovations as defined in the architectural and M.E.P. drawings will impact identified asbestos containing building materials. Removal of all identified asbestos containing building materials in the path of construction shall be abated prior to disturbance from renovation activities. All removal, transportation, disposal, air monitoring and other regulatory protocols shall be completed by personnel licensed in the State of Texas and in accordance with all applicable AHERA, TAHPR and/or NESHAP regulations.**
- \* **It is recommended that the general contractor shall provide at the minimum the 2-hour OSHA Asbestos Awareness training for all trades personnel working at the campus during the renovations.**

## CONCLUSION

We understand that PBK and CFISD have proposed select renovations and demolition for the Arnold Middle School campus. It should be noted that all renovation and demolition activities are governed by EPA NESHAP regulations, OSHA - Administration Construction Industry Standard regulations (Occupational Safety and Health Act, 29 CFR 1926.1101) and the Texas Department of State Health Services – Texas Asbestos Health Protection Rules (TAHPR), as amended July 2021.

Based upon the sampling and laboratory results, asbestos was detected in components designated by the Architect to be impacted by the proposed renovations and demolition. Therefore, EFI recommends the abatement of the identified ACM along with corresponding communications of the potential asbestos hazards prior to other trades occupying the work zones. EFI will provide additional investigations and sample any suspect materials discovered during the demolition/excavation process under a separate cover.

Asbestos abatement work in public buildings, especially school facilities, are required under the revised Model Accreditation Plan (MAP) and TDSHS regulations, to be designed by an accredited/licensed Project Designer and must be performed with the proper engineering and regulatory controls by a licensed asbestos abatement contractor. Air monitoring should also be provided by licensed asbestos personnel under contract to the building owner. Should additional



work changes and/or increased scope of work be proposed, please contact EFI for additional discussion and sampling review.

### **LIMITATIONS**

This report has been prepared to assist PBK and Cypress-Fairbanks Independent School District in determining the extent of asbestos-containing building materials (ACBM) at the Arnold Middle School campus. This report only describes the conditions present at the time of our survey, and the results presented herein are based upon the information available at the time of our survey. The condition of ACBM may change gradually or suddenly, depending upon use, maintenance, or accident. This survey included limited destructive sampling of walls and other building materials. Consequently, observations of wall cavities, chases, and other concealed areas were limited. If other materials are encountered during renovations, we recommend contacting EFI to arrange for sampling of those affected materials.

The survey was limited to accessible areas, as directed by PBK and our work excluded the underground items and other building components that were not designated for impact as part of the demolition process proposed at this facility.

Our professional services have been performed using that degree of skill and care ordinarily exercised, under similar conditions, by reputable asbestos consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional information in this report. EFI reserves the right to alter our findings based on our review of any information obtained and reviewed after the date of this report. This report is prepared for the sole benefit of Cypress-Fairbanks Independent School District, PBK Architects, Inc. and may not be relied upon by any other person or entity without the written authorization of EFI Global.

**APPENDIX A1**

**LABORATORY REPORTS**



## Polarized Light Microscopy Analysis

EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
01-01 MAS588091	1	Brown fibrous floor tile	Yes	2% Chrysotile	98% Other
01-01 MAS588091	2	Black fibrous mastic	Yes	5% Chrysotile	95% Mastic
02-01 MAS588092	1	Yellow non-fibrous mastic	No		100% Mastic
02-01 MAS588092	2	Black non-fibrous foam	No		100% Foam
02-02 MAS588093	1	Yellow non-fibrous mastic	No		100% Mastic
02-02 MAS588093	2	Grey fibrous leveling material	No		5% Cellulose 95% Other
02-03 MAS588094	1	Yellow non-fibrous mastic	No		100% Mastic
02-03 MAS588094	2	Grey fibrous leveling material	No		5% Cellulose 95% Other
03-01 MAS588095	1	Yellow non-fibrous carpet mastic	No		100% Mastic
03-02 MAS588096	1	Yellow non-fibrous carpet mastic	No		100% Mastic
03-03 MAS588097	1	Yellow non-fibrous carpet mastic	No		100% Mastic
04-01 MAS588098	1	Grey non-fibrous vinyl floor tile	No		100% Vinyl
04-01 MAS588098	2	Tan non-fibrous mastic	No		100% Mastic
04-01 MAS588098	3	Grey fibrous leveling material	No		5% Cellulose 95% Other

Samples have been analyzed by the EPA - 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, EPA - 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Material. The test results herein relate only to the sample submitted and analyzed. This report may only be reproduced in full with the approval of the Bulk Asbestos Laboratory of Micro Analytical Services (MAS). The above percentages are visual estimates of area percent. MAS is not responsible for any errors resulting from improper or incorrect sampling or shipping procedures. These samples will be retained for a period of 30 days. Accreditation by NVLAP in no way constitutes or implies product certification, approval, or endorsement by NIST. Some materials, especially floor tiles, contain asbestos fibers too thin to be detected by this method. NVLAP Lab Code: 200618 TDSHS License: 30-0341

**Analyzed by:** Tony Dang

**Approved NVLAP Signatory:** Tony Dang  
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EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
04-02 MAS588099	1	Grey non-fibrous vinyl floor tile	No		100% Vinyl
04-02 MAS588099	2	Tan non-fibrous mastic	No		100% Mastic
04-02 MAS588099	3	Grey fibrous leveling material	No		5% Cellulose 95% Other
04-03 MAS588100	1	Grey non-fibrous vinyl floor tile	No		100% Vinyl
04-03 MAS588100	2	Tan non-fibrous mastic	No		100% Mastic
04-03 MAS588100	3	Grey fibrous leveling material	No		5% Cellulose 95% Other
05-01 MAS588101	1	Grey non-fibrous epoxy floor material	No		100% Other
05-02 MAS588102	1	Grey non-fibrous epoxy floor material	No		100% Other
05-03 MAS588103	1	Grey non-fibrous epoxy floor material	No		100% Other
06-01 MAS588104	1	Yellow non-fibrous mastic	No		100% Mastic
06-01 MAS588104	2	White non-fibrous floor tile	No		100% Other
06-01 MAS588104	3	Yellow non-fibrous mastic	No		100% Mastic
06-02 MAS588105	1	White non-fibrous floor tile	No		100% Other
06-02 MAS588105	2	Yellow non-fibrous mastic	No		100% Mastic

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Houston, Texas 77077

MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
06-02 MAS588105	3	Grey fibrous leveling material	No		5% Cellulose 95% Other
06-03 MAS588106	1	White non-fibrous floor tile	No		100% Other
06-03 MAS588106	2	Yellow non-fibrous mastic	No		100% Mastic
07-01 MAS588107	1	Black fibrous mastic	Yes	4% Chrysotile	96% Mastic
08-01 MAS588108	1	Black fibrous sink undercoating	Yes	2% Chrysotile	98% Other
09-01 MAS588109	1	Black non-fibrous sink undercoating	No		100% Other
09-02 MAS588110	1	Black non-fibrous sink undercoating	No		100% Other
09-03 MAS588111	1	Black non-fibrous sink undercoating	No		100% Other
10-01 MAS588112	1	Grey non-fibrous floor tile	No		100% Other
10-01 MAS588112	2	Yellow non-fibrous mastic	No		100% Mastic
10-02 MAS588113	1	Grey non-fibrous floor tile	No		100% Other
10-02 MAS588113	2	Yellow non-fibrous mastic	No		100% Mastic
10-03 MAS588114	1	Grey non-fibrous floor tile	No		100% Other
10-03 MAS588114	2	Yellow non-fibrous mastic	No		100% Mastic

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MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
11-01 MAS588115	1	Tan non-fibrous carpet pad	No		100% Foam
11-01 MAS588115	2	Clear non-fibrous glue	No		100% Glue
11-02 MAS588116	1	Tan non-fibrous carpet pad	No		100% Foam
11-02 MAS588116	2	Clear non-fibrous glue	No		100% Glue
11-03 MAS588117	1	Tan non-fibrous carpet pad	No		100% Foam
11-03 MAS588117	2	Clear non-fibrous glue	No		100% Glue
12-01 MAS588118	1	Tan non-fibrous carpet pad	No		100% Foam
12-01 MAS588118	2	Clear non-fibrous glue	No		100% Glue
12-02 MAS588119	1	Tan non-fibrous carpet pad	No		100% Foam
12-02 MAS588119	2	Clear non-fibrous glue	No		100% Glue
12-03 MAS588120	1	Tan non-fibrous carpet pad	No		100% Foam
12-03 MAS588120	2	Clear non-fibrous glue	No		100% Glue
13-01 MAS588121	1	Beige non-fibrous floor tile with grey streaks	No		100% Other
13-01 MAS588121	2	Yellow non-fibrous mastic	No		100% Mastic

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Houston, Texas 77077

MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
13-02 MAS588122	1	Beige non-fibrous floor tile with grey streaks	No		100% Other
13-02 MAS588122	2	Yellow non-fibrous mastic	No		100% Mastic
13-03 MAS588123	1	Beige non-fibrous floor tile with grey streaks	No		100% Other
13-03 MAS588123	2	Yellow non-fibrous mastic	No		100% Mastic
13-03 MAS588123	3	Grey fibrous leveling material	No		5% Cellulose 95% Other
14-01 MAS588124	1	Grey fibrous sink undercoating	No		5% Cellulose 95% Other
14-02 MAS588125	1	Grey fibrous sink undercoating	No		5% Cellulose 95% Other
15-01 MAS588126	1	Black fibrous mastic	Yes	5% Chrysotile	95% Mastic
15-02 MAS588127	1	Black fibrous mastic	No		2% Cellulose 98% Mastic
15-03 MAS588128	1	Black fibrous mastic	Yes	5% Chrysotile	95% Mastic
16-01 MAS588129	1	Beige fibrous insulation	Yes	7% Chrysotile	93% Other
16-02 MAS588130	1	Beige fibrous insulation	Yes	7% Chrysotile	93% Other
16-03 MAS588131	1	Beige fibrous insulation	Yes	7% Chrysotile	93% Other
17-01 MAS588132	1	Brown fibrous paper with foil backing	No		50% Cellulose 50% Foil

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MAS Project #: 19330-00  
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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
17-01 MAS588132	2	Black fibrous mastic	Yes	5% Chrysotile	95% Mastic
18-01 MAS588133	1	Beige fibrous window glaze	Yes	3% Chrysotile	97% Other
19-01 MAS588134	1	Black non-fibrous mastic with paint	No		90% Mastic 10% Other
20-01 MAS588135	1	Beige fibrous insulation	Yes	3% Chrysotile	5% Cellulose 10% Perlite 82% Other
20-01 MAS588135	2	Beige non-fibrous plaster	No		70% Aggregate 30% Other
20-02 MAS588136	1	Beige fibrous insulation	Yes	3% Chrysotile	5% Cellulose 10% Perlite 82% Other
20-02 MAS588136	2	Beige non-fibrous plaster	No		70% Aggregate 30% Other
20-03 MAS588137	1	Beige fibrous insulation	Yes	3% Chrysotile	5% Cellulose 10% Perlite 82% Other
21-01 MAS588138	1	Tan non-fibrous mastic	No		100% Mastic
21-02 MAS588139	1	Tan non-fibrous mastic	No		100% Mastic
21-02 MAS588139	2	Silver non-fibrous metal	No		100% Galvanize
21-02 MAS588139	3	Reddish/brown non-fibrous wire	No		100% Copper
21-03 MAS588140	1	Brown non-fibrous mastic	No		100% Mastic

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MAS Project #: 19330-00  
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Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
22-01 MAS588141	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
22-02 MAS588142	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
22-03 MAS588143	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
22-04 MAS588144	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
22-05 MAS588145	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
22-06 MAS588146	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
22-07 MAS588147	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other

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*Project Name:* Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
23-01 MAS588148	1	Pink fibrous sink undercoating	Yes	2% Chrysotile	98% Other
24-01 MAS588149	1	Black fibrous damp proofing	Yes	5% Chrysotile	95% Mastic
24-01 MAS588149	2	Red non-fibrous brick	No		100% Other
24-01 MAS588149	3	Black fibrous roofing material	No		10% Cellulose 90% Asphalt
24-01 MAS588149	4	Reddish/brown fibrous copper	No		100% Copper
25-01 MAS588150	1	White non-fibrous texture	No		100% Other
25-01 MAS588150	2	White non-fibrous joint compound with beige paper	No		70% Cellulose 30% Other
25-01 MAS588150	3	White fibrous gypsum with brown paper	No		70% Cellulose 30% Gypsum
25-02 MAS588151	1	White non-fibrous texture with white paint	No		100% Other
25-02 MAS588151	2	White non-fibrous joint compound with beige paper	No		70% Cellulose 30% Other
25-02 MAS588151	3	White fibrous gypsum with brown paper	No		70% Cellulose 30% Gypsum
25-03 MAS588152	1	White non-fibrous texture with white paint	No		100% Other
25-03 MAS588152	2	White non-fibrous joint compound with beige paper	No		70% Cellulose 30% Other
25-03 MAS588152	3	White fibrous gypsum with brown paper	No		70% Cellulose 30% Gypsum

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MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
26-01 MAS588153	1	Beige non-fibrous epoxy	No		100% Other
26-02 MAS588154	1	Beige non-fibrous epoxy	No		100% Other
26-03 MAS588155	1	Beige non-fibrous epoxy	No		100% Other
27-01 MAS588156	1	White fibrous mastic	No		5% Wollastonite 95% Mastic
27-01 MAS588156	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
27-01 MAS588156	3	Yellow fibrous glass insulation	No		100% fibrous Glass
27-02 MAS588157	1	White fibrous mastic	No		5% Wollastonite 95% Mastic
27-02 MAS588157	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
27-02 MAS588157	3	Yellow fibrous glass insulation	No		100% fibrous Glass
27-03 MAS588158	1	White fibrous mastic	No		5% Wollastonite 95% Mastic
27-03 MAS588158	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
27-03 MAS588158	3	Yellow fibrous glass insulation	No		100% fibrous Glass

Samples have been analyzed by the EPA - 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, EPA - 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Material. The test results herein relate only to the sample submitted and analyzed. This report may only be reproduced in full with the approval of the Bulk Asbestos Laboratory of Micro Analytical Services (MAS). The above percentages are visual estimates of area percent. MAS is not responsible for any errors resulting from improper or incorrect sampling or shipping procedures. These samples will be retained for a period of 30 days. Accreditation by NVLAP in no way constitutes or implies product certification, approval, or endorsement by NIST. Some materials, especially floor tiles, contain asbestos fibers too thin to be detected by this method. NVLAP Lab Code: 200618 TDSHS License: 30-0341

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## Polarized Light Microscopy Analysis

EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
28-01 MAS588159	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
28-01 MAS588159	2	Yellow fibrous glass insulation	No		100% fibrous Glass
28-02 MAS588160	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
28-02 MAS588160	2	Yellow fibrous glass insulation	No		100% fibrous Glass
28-03 MAS588161	1	White fibrous mastic	No		5% Wollastonite 95% Mastic
23-03 MAS588161	2	Green non-fibrous foam	No		100% Foam
28-04 MAS588162	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
28-04 MAS588162	2	Yellow non-fibrous foam	No		100% Foam
28-05 MAS588163	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
28-05 MAS588163	2	Yellow non-fibrous foam	No		100% Foam
29-01 MAS588164	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other

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29-01 MAS588164	2	Yellow fibrous glass insulation	No		100% fibrous Glass
29-02 MAS588165	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
29-02 MAS588165	2	Yellow fibrous glass insulation	No		100% fibrous Glass
29-03 MAS588166	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
29-03 MAS588166	2	Yellow fibrous glass insulation	No		100% fibrous Glass
29-04 MAS588167	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
29-04 MAS588167	2	Yellow fibrous glass insulation	No		100% fibrous Glass
29-05 MAS588168	1	White fibrous mastic	No		5% Wollastonite 15% fibrous Glass 80% Other
29-05 MAS588168	2	Yellow fibrous glass insulation	No		100% fibrous Glass
30-01 MAS588169	1	Black non-fibrous mastic	No		100% Mastic
30-01 MAS588169	2	Reddish/brown non-fibrous copper	No		100% Copper
30-02 MAS588170	1	Black non-fibrous mastic	No		100% Mastic

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
30-02 MAS588170	2	Reddish/brown non-fibrous copper	No		100% Copper
30-03 MAS588171	1	Black non-fibrous mastic	No		100% Mastic
30-03 MAS588171	2	Reddish/brown non-fibrous copper	No		100% Copper
31-01 MAS588172	1	Silver non-fibrous foil	No		100% Foil
31-01 MAS588172	2	White fibrous mastic	No		5% Wollastonite 95% Mastic
31-01 MAS588172	3	Black non-fibrous mastic	No		100% Mastic
31-01 MAS588172	4	Tan non-fibrous foam	No		100% Foam
31-02 MAS588173	1	White fibrous mastic	No		5% Wollastonite 95% Mastic
31-02 MAS588173	2	Black non-fibrous mastic	No		100% Mastic
31-02 MAS588173	3	Tan non-fibrous foam	No		100% Foam
31-03 MAS588174	1	White fibrous mastic	No		5% Wollastonite 95% Mastic
31-03 MAS588174	2	Black non-fibrous mastic	No		100% Mastic
31-03 MAS588174	3	Tan non-fibrous foam	No		100% Foam
32-01 MAS588175	1	Black non-fibrous mastic	No		100% Mastic

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
32-01 MAS588175	2	Tan non-fibrous foam	No		100% Foam
32-02 MAS588176	1	Black non-fibrous mastic	No		100% Mastic
32-02 MAS588176	2	Tan non-fibrous foam	No		100% Foam
32-03 MAS588177	1	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
32-03 MAS588177	2	Black non-fibrous mastic	No		100% Mastic
32-03 MAS588177	3	Tan non-fibrous foam	No		100% Foam
33-01 MAS588178	1	Beige fibrous rope gasket	No		5% Cellulose 75% fibrous Glass 20% Other
33-02 MAS588179	1	Beige fibrous rope gasket	No		5% Cellulose 75% fibrous Glass 20% Other
33-03 MAS588180	1	Beige fibrous rope gasket	No		5% Cellulose 75% fibrous Glass 20% Other
34-01 MAS588181	1	White fibrous glass insulation	No		100% fibrous Glass
34-02 MAS588182	1	White fibrous glass insulation	No		100% fibrous Glass
34-03 MAS588183	1	White fibrous glass insulation	No		100% fibrous Glass

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
35-01 MAS588184	1	Light green fibrous gasket	No		80% Cellulose 20% Other
35-02 MAS588185	1	Light green fibrous gasket	No		80% Cellulose 20% Other
35-03 MAS588186	1	Light green fibrous gasket	No		80% Cellulose 20% Other
36-01 MAS588187	1	White non-fibrous mastic	No		100% Mastic
36-01 MAS588187	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
36-01 MAS588187	3	Yellow fibrous glass insulation	No		100% fibrous Glass
36-02 MAS588188	1	White non-fibrous mastic	No		100% Mastic
36-02 MAS588188	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
36-02 MAS588188	3	Yellow fibrous glass insulation	No		100% fibrous Glass
36-03 MAS588189	1	White non-fibrous mastic	No		100% Mastic
36-03 MAS588189	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
36-03 MAS588189	3	Yellow fibrous glass insulation	No		100% fibrous Glass

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
37-01 MAS588190	1	Black fibrous mastic	No		5% Cellulose 95% Mastic
37-01 MAS588190	2	Yellow non-fibrous foam	No		100% Foam
37-02 MAS588191	1	Black fibrous mastic	No		5% Cellulose 95% Mastic
37-02 MAS588191	2	Yellow non-fibrous foam	No		100% Foam
37-02 MAS588191	3	Grey non-fibrous sealant	No		100% Other
37-03 MAS588192	1	Black fibrous mastic	No		5% Cellulose 95% Mastic
37-03 MAS588192	2	Yellow non-fibrous foam	No		100% Foam
38-01 MAS588193	1	Black non-fibrous damp proofing	No		100% Mastic
38-01 MAS588193	2	Dark grey non-fibrous CMU	No		80% Aggregate 20% Other
39-01 MAS588194	1	Grey fibrous transite	Yes	40% Chrysotile	60% Other
40-01 MAS588195	1	Beige non-fibrous epoxy	No		100% Other
40-02 MAS588196	1	Beige non-fibrous epoxy	No		100% Other
40-03 MAS588197	1	Beige non-fibrous epoxy	No		100% Other
41-01 MAS588198	1	White fibrous joint compound	No		15% fibrous Glass 85% Other

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
41-01 MAS588198	2	White fibrous gypsum with brown paper	No		60% Cellulose 40% Gypsum
41-02 MAS588199	1	White non-fibrous joint compound with white paint	No		100% Other
41-03 MAS588200	1	White non-fibrous joint compound with white paint	No		100% Other
41-03 MAS588200	2	White fibrous gypsum with brown paper	No		60% Cellulose 40% Gypsum
42-01 MAS588201	1	White fibrous mastic	No		15% fibrous Glass 85% Mastic
42-01 MAS588201	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
42-01 MAS588201	3	Yellow fibrous glass insulation	No		100% fibrous Glass
42-02 MAS588202	1	White fibrous mastic	No		15% fibrous Glass 85% Mastic
42-02 MAS588202	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil
42-02 MAS588202	3	Yellow fibrous glass insulation	No		100% fibrous Glass
42-03 MAS588203	1	White fibrous mastic	No		15% fibrous Glass 85% Mastic
42-03 MAS588203	2	White fibrous paper with foil backing	No		10% fibrous Glass 45% Cellulose 45% Foil

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
42-01 MAS588203	3	Yellow fibrous glass insulation	No		100% fibrous Glass
43-01 MAS588204	1	Tan fibrous fireproofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
43-02 MAS588205	1	Tan fibrous fireproofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
43-03 MAS588206	1	Tan fibrous fireproofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
44-01 MAS588207	1	Tan non-fibrous carpet	No		100% Foam
44-01 MAS588207	2	Clear non-fibrous glue	No		100% Glue
44-02 MAS588208	1	Tan non-fibrous carpet	No		100% Foam
44-02 MAS588208	2	Clear non-fibrous glue	No		100% Glue
44-03 MAS588209	1	Tan non-fibrous carpet	No		100% Foam
44-03 MAS588209	2	Clear non-fibrous glue	No		100% Glue
45-01 MAS588210	1	Beige non-fibrous cove base mastic	No		100% Mastic

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
45-02 MAS588211	1	Beige non-fibrous cove base mastic	No		100% Mastic
45-03 MAS588212	1	Beige non-fibrous cove base mastic	No		100% Mastic
46-01 MAS588213	1	White non-fibrous CMU block filler	No		30% Aggregate 70% Other
46-02 MAS588214	1	White non-fibrous CMU block filler	No		30% Aggregate 70% Other
46-03 MAS588215	1	White non-fibrous CMU block filler	No		30% Aggregate 70% Other
47-01 MAS588216	1	White non-fibrous texture with beige paint	No		100% Other
47-01 MAS588216	2	White non-fibrous joint compound with beige paper	No		70% Cellulose 30% Other
47-01 MAS588216	3	White fibrous gypsum with brown paper	No		40% Cellulose 60% Gypsum
47-02 MAS588217	1	White non-fibrous texture with beige paint	No		100% Other
47-02 MAS588217	2	White non-fibrous joint compound with beige paper	No		70% Cellulose 30% Other
47-02 MAS588217	3	White fibrous gypsum with brown paper	No		40% Cellulose 60% Gypsum
47-03 MAS588218	1	White non-fibrous texture with beige paint	No		100% Other
47-03 MAS588218	2	White non-fibrous joint compound with beige paper	No		70% Cellulose 30% Other
47-03 MAS588218	3	White fibrous gypsum with brown paper	No		40% Cellulose 60% Gypsum

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Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
48-01 MAS588219	1	Tan fibrous fire proofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
48-02 MAS588220	1	Tan fibrous fire proofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
48-03 MAS588221	1	Tan fibrous fire proofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
49-01 MAS588222	1	Black non-fibrous damp proofing with white material	No		80% Mastic 20% Other
50-01 MAS588223	1	Grey fibrous transite	Yes	40% Chrysotile	60% Other
51-01 MAS588224	1	Black fibrous damp proofing	Yes	7% Chrysotile	93% Mastic
51-01 MAS588224	2	Dark grey non-fibrous CMU	No		80% Aggregate 20% Other
52-01 MAS588225	1	Tan fibrous fire proofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other
52-02 MAS588226	1	Tan fibrous fire proofing	No		10% fibrous Glass 20% Cellulose 20% Mica 50% Other

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53-01 MAS588228	1	Black fibrous damp proofing	Yes	7% Chrysotile	13% fibrous Glass 80% Mastic
53-01 MAS588228	2	Tan non-fibrous brick	No		100% Other
54-01 MAS588229	1	Grey fibrous fire proofing	No		90% Mineral Wool 10% Other
54-02 MAS588230	1	Grey fibrous fire proofing	No		90% Mineral Wool 10% Other
54-03 MAS588231	1	Grey fibrous fire proofing	No		90% Mineral Wool 10% Other
55-01 MAS588232	1	Grey fibrous mud fitting	No		30% Mineral Wool 70% Other
56-01 MAS588233	1	Black fibrous damp proofing	Yes	7% Chrysotile	13% fibrous Glass 80% Mastic
56-01 MAS588233	2	Dark grey non-fibrous CMU and mortar	No		80% Aggregate 20% Other
57-01 MAS588234	1	Black fibrous damp proofing	Yes	7% Chrysotile	13% fibrous Glass 80% Mastic
57-01 MAS588234	2	Dark grey non-fibrous CMU and mortar	No		80% Aggregate 20% Other
58-01 MAS588235	1	Beige non-fibrous plaster	No		70% Aggregate 30% Other
58-01 MAS588235	2	Beige fibrous insulation	Yes	7% Chrysotile	30% Mica 63% Other
58-02 MAS588236	1	Beige fibrous insulation	Yes	7% Chrysotile	30% Mica 63% Other
58-03 MAS588237	1	Beige fibrous insulation	Yes	7% Chrysotile	30% Mica 63% Other

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Houston, Texas 77077

MAS Project #: 19330-00  
Date Received: 12/13/2024  
Date Analyzed: 12/17/2024

*Project Name:* Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
59-01 MAS588238	1	Off-white fibrous over spray	Yes	7% Chrysotile	97% Other

Samples have been analyzed by the EPA - 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, EPA - 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Material. The test results herein relate only to the sample submitted and analyzed. This report may only be reproduced in full with the approval of the Bulk Asbestos Laboratory of Micro Analytical Services (MAS). The above percentages are visual estimates of area percent. MAS is not responsible for any errors resulting from improper or incorrect sampling or shipping procedures. These samples will be retained for a period of 30 days. Accreditation by NVLAP in no way constitutes or implies product certification, approval, or endorsement by NIST. Some materials, especially floor tiles, contain asbestos fibers too thin to be detected by this method. NVLAP Lab Code: 200618 TDSHS License: 30-0341

*Analyzed by:* Tony Dang

*Approved NVLAP Signatory:* Tony Dang  
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Micro Analytical Services, Inc. 11301 Richmond Ave. Suite K100B ♦ Houston ♦ Texas 77082 ♦ Phone (281) 497-4500 ♦ Fax (281) 497-4517

### Asbestos Bulk Sample Chain of Custody

Company: EFI Global, Inc.	Contact: Kenneth Capps	Project Name: <i>Arnold NS</i>
Address: 2000 South Dairy Ashford Suite 600	Bill to: EFI Global	Project #: <i>029.07189</i>
City: Houston	Email: Kenneth.Capps@efiglobal.com	PO #:
State/Zip: TEXAS, 77077	Rick.Anderson@efiglobal.com	MAS Project #: <i>19330</i>
Phone: (832) 518-5145	Ginger.Denman@efiglobal.com	
Fax: (832) 518-5157	Date Collected: <i>12-5-24</i>	

Turn around time (circle): Emergency 1-day 2-day 3-day 4-day 5-day Total # of samples 151  
Positive stop YES or NO

Field ID	Sample Description	Sample Location Arch. DWG	Comments
<i>1-1</i>	<i>9x9 VST Brown w/ Black Maska</i>	<i>Corridor E422</i>	<i>1957 Ad (150 sq)</i>
<i>2-1</i>	<i>Brown / Yellow Carpet Maska</i>	<i>Rm E411</i>	<i>1964 Ad</i>
<i>2-2</i>		<i>Rm E413</i>	
<i>2-3</i>		<i>Rm E406</i>	
<i>3-1</i>	<i>Yellow Carpet Maska</i>	<i>Rm B919</i>	<i>1980's Ad</i>
<i>3-2</i>		<i>Rm A925</i>	
<i>3-3</i>		<i>Rm <del>A913</del> A913B</i>	
<i>4-1</i>	<i>6" x 4" Gray VST w/ Tan Glue</i>	<i>Rm B919</i>	<i>1980's Ad</i>
<i>4-2</i>	<i>+ float</i>	<i>Rm A913</i>	
<i>5-1</i>	<i>Epoxy floor</i>	<i>Art B922</i>	<i>1980's Ad</i>
<i>5-2</i>			
<i>5-3</i>		<i>B924</i>	
<i>6-1</i>	<i>12" White &amp; Gray VST w/ Yellow Maska</i>	<i>Theater Art A919 - Closet</i>	<i>1980's Ad</i>
<i>6-2</i>		<i>- Mass Rm</i>	
<i>6-3</i>		<i>- Paint Store</i>	
<i>7-1</i>	<i>Residual Black Maska</i>	<i>A98D - Storage</i>	
<i>8-1</i>	<i>Shiny Gray Sink Under coat</i>		

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Relinquished by: *[Signature]* Date: *12-13-24* Time: *5:06 pm*  
 Received by: *Tony Dang* Date: *12/13/24* Time: *5:06 pm*  
 Relinquished by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Received by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Project Name: Arnold ms.  
 Project #: 029,07189

Field ID	Sample Description	Sample Location	Comments
9-1	Black Sinter Undercoating	Science D507	1968
-2	↓	D501	↓
-3	↓	D513	↓
10-1	12" White & Gray VST w/ Brandywine	Science D507	1968
-2	↓	D501	↓
-3	↓	D513	↓
11-1	Carpet Pad + Glue w/ Yellow Mastic	Corr % Rm D501	<del>1968</del> 1968
11-2	↓	% Cor D505	↓
-3	↓	% Rm D504	↓
12-1	Carpet Pad + Glue	Rm F11	1964
-2	↓	Rm F116	↓
-3	↓	Rm F117	↓
13-1	12" Beige/Gray VST w/ Yellow Mastic on float	Rm G229	1964
-2	↓	G 228	↓
-3	↓	G 204	↓
14-1	Gray Sinter Undercoating	Chem	
-2	↓	Hone CC	
<hr/>			
15-1	Residual Black Floor Mastic	G 236	1955 6" wide Strips, Entire
-2	↓	H 305 Reham	1964
-3	↓	1/2 Corr Hole Mach	1964
16-1	Residual Soft Texture on Concrete Deck Panel	% Rm F117	1957 Adv
-2	↓	Rm F118 Back Wall	↓
-3	↓	Rm F113 above Door	↓
17-1	Black Mastic on Pipe Insulation	Above lockers % R15	- Debris throughout & above
18-1	Window Glazing Putty on Abundant Windows	Rm F118	Whole wing
19-1	Black Chalk board Mastic - Residue	F Mechanical Rm	1957 -
20-1	Joint Filler (Plaster)	Corridor at Library	1955
-2	↓	Rm G237	↓
-3	↓	% Rm H 309	↓
21-1	Brown Stip Pin mastic on concrete deck Panel	Rm G237	1955
-2	↓	Boys Locker Rm	1955
-3	↓	Rm B802	1957
22-1	2x2 Pinhole Ceiling Panel	Corr % Rm F112	
-2	↓	Rm G 237	
-3	↓	Rm 609	
-4	↓	Rehersal	2009
-5	↓	Band	1964
-6	↓	Rm B806	1957
-7	↓	% Rm B924	1740/80
23-1	Pink Sinter Undercoating	SP6D	1955
<hr/>			
24-1	Damp proof on Clay Block w/ Copper Flash	@ Rm H309	1955 666

Project Name: Arnold MS

Project #: 02907109

Field ID	Sample Description	Sample Location	Comments
25-1	Copper Castings w/ Joint Compound	Girls PG Locker Rm	
26-1	Epoxy Flooring	Girls PG Locker Rm	
27-1	Domestic Hot Water Pipe Ins. w/ White Mastic	Girls PG Locker Rm Coach Off	
28-1	Critical Water Pipe Ins. w/ White Mastic	North Roof	
29-1	Heating Water Pipe Ins. w/ White Mastic	North Roof	
30-1	Through wall Flashing w/ Black Mastic	2009 Bldg Adv - Roo	
31-1	Critical Water Pipe Ins. w/ Black Adhesive w/ White Mastic on Runs	2009 Bldg Adv	
32-1	Heating Water Pipe Ins. w/ Black Adhesive on Runs	2009 Bldg Adv	
33-1	Barber Rope Gasket	Barber Rm B2	
34-1	Barber Tank Insulation	Barber Rm B1	
35-1	Gaskets - @ Flange	Barber Rm B2	
36-1	Heating Water Pipe Insulation w/ White Mastic	Heating Water Pump B2	
37-1	Black Sealant on Heating Water Pipe Ins. going into beam	Pipe fittings @ Grand beam 2/3 Barber Rm	
38-1	Black Damp-proof on Arch	Boys Locker Rm	1968 Add
39-1	Concrete Panel - above Door	Boys Locker Rm Entrance	

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Project Name: Arnold MS

Project #: 029-07689

Field ID	Sample Description	Sample Location	Comments
40-1	Epoxy Slab	Boys Locker Rm	
-2	↓	↓	
-3	↓	↓	
41-1	Gypsum Ceiling w/ Joint Compound	Boys Locker Rm	
-2	↓	↓	
-3	↓	↓	
42-1	Parastik Hot Water Pipe Ins. w/ White Mastik	Boys Locker Rm	
-2	↓	↓	
-3	↓	↓	
43-1	Tan Fireproofing	1965 Addition Boys Locker Rm	
-2	↓	E413	1965 Add
-3	↓	E402	
44-1	Carpet Pad & Glue	Rehearsal Rm H310	2009 Bldg
-2	↓	↓	↓
-3	↓	↓	↓
45-1	Cove Base Mastik	↓	↓
-2	↓	↓	↓
-3	↓	↓	↓
46-1	CMU Block Filler	↓	↓
-2	↓	↓	↓
-3	↓	↓	↓
47-1	Gypsum Ceiling/wall board w/ Surf Compound	↓	↓
-2	↓	↓	↓
-3	↓	↓	↓
48-1	Tan Fireproofing	Rehearsal	↓
-2	↓	↓	↓
-3	↓	↓	↓
49-1	Dampproofing & Flashing on CMU	↓	2009 Bldg
50-1	Translucent paint @ origin wall	Rm H306	1955 Bldg
51-1	Dampproofing on CMU w/ Flasher	Corr of Cafeteria	1977/80 Add
52-1	Fireproofing - Tan/Gray	Corr of Cafeteria	1977/80 Add
-2	↓	↓	↓
-3	↓	↓	↓
53-1	Dampproofing on Clay Block	Corr of Band/Rehearsal	1964 Add
54-1	"Fluffy" Fireproofing	Rehearsal/Band H304	1964 Add
-2	↓	Rm HOLE Mech	
-3	↓	↓	
55-1	Muddled Lifting Debris on Ceiling	% of Rm G 217 Admin.	1964
56-1	Grey Fireproofing on columns of 1st fl	Rm E413	1965 Admin
57-1	Black Dampproofing on CMU & Mortar	Rm G 505 Mechanical	1965 Add
58-1	Plaster Joint Filler/Texture	Rm G 410	1968 Add
-2	↓	% Rm B 802	1957 Add
-3	↓	Rm B 805	
59-1	White over spray on Concrete Decking	Rm B 809	↓
		Boys RR	1957 Add



## Polarized Light Microscopy Analysis

EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19413-00  
Date Received: 01/28/2025  
Date Analyzed: 01/29/2025

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
60-1 MAS590564	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
60-2 MAS590565	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
60-3 MAS590566	1	Beige fibrous ceiling tile with white paint	No		10% Mineral Wool 40% Cellulose 30% Perlite 20% Other
61-1 MAS590567	1	Grey non-fibrous sealant	No		100% Other
61-2 MAS590568	1	Grey non-fibrous sealant	No		100% Other
61-3 MAS590569	1	Grey non-fibrous sealant	No		100% Other
62-1 MAS590570	1	Beige fibrous fire proofing	No		5% Mica 25% Cellulose 70% Other
62-2 MAS590571	1	Beige fibrous fire proofing	No		5% Mica 25% Cellulose 70% Other
62-3 MAS590572	1	Beige fibrous fire proofing	No		5% Mica 25% Cellulose 70% Other
63-1 MAS590573	1	Black non-fibrous damp proofing	No		100% Mastic

Samples have been analyzed by the EPA - 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, EPA - 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Material. The test results herein relate only to the sample submitted and analyzed. This report may only be reproduced in full with the approval of the Bulk Asbestos Laboratory of Micro Analytical Services (MAS). The above percentages are visual estimates of area percent. MAS is not responsible for any errors resulting from improper or incorrect sampling or shipping procedures. These samples will be retained for a period of 30 days. Accreditation by NVLAP in no way constitutes or implies product certification, approval, or endorsement by NIST. Some materials, especially floor tiles, contain asbestos fibers too thin to be detected by this method. NVLAP Lab Code: 200618 TDSHS License: 30-0341

**Analyzed by:** Tony Dang

**Approved NVLAP Signatory:** Tony Dang  
Page 1 of 4



## Polarized Light Microscopy Analysis

EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19413-00  
Date Received: 01/28/2025  
Date Analyzed: 01/29/2025

**Project Name:** Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
63-1 MAS590573	2	Grey non-fibrous CMU	No		80% Aggregate 20% Other
63-1 MAS590573	3	Light babe blue non-fibrous foam	No		100% Foam
63-2 MAS590574	1	Black non-fibrous damp proofing	No		100% Mastic
63-2 MAS590574	2	Grey non-fibrous CMU	No		80% Aggregate 20% Other
63-2 MAS590574	3	Light babe blue non-fibrous foam	No		100% Foam
63-3 MAS590575	1	Black non-fibrous damp proofing	No		100% Mastic
63-3 MAS590575	2	Grey non-fibrous CMU	No		80% Aggregate 20% Other
63-3 MAS590575	3	Light babe blue non-fibrous foam	No		100% Foam
64-1 MAS590576	1	Black non-fibrous damp proofing	No		100% Mastic
64-1 MAS590576	2	White fibrous gypsum with brown paper	No		5% fibrous Glass 55% Cellulose 40% Gypsum
64-2 MAS590577	1	Black non-fibrous damp proofing	No		100% Mastic
64-2 MAS590577	2	White fibrous gypsum with brown paper	No		5% fibrous Glass 55% Cellulose 40% Gypsum
64-3 MAS590578	1	Black non-fibrous damp proofing	No		100% Mastic

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Analyzed by: Tony Dang

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Page 2 of 4



## Polarized Light Microscopy Analysis

EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19413-00  
Date Received: 01/28/2025  
Date Analyzed: 01/29/2025

*Project Name:* Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
64-3 MAS590578	2	White fibrous gypsum with brown paper	No		5% fibrous Glass 55% Cellulose 40% Gypsum
65-1 MAS590579	1	White non-fibrous plaster	No		70% Aggregate 30% Other
65-2 MAS590580	1	White non-fibrous plaster	No		70% Aggregate 30% Other
65-3 MAS590581	1	White non-fibrous plaster	No		70% Aggregate 30% Other
66-1 MAS590582	1	Grey non-fibrous door caulking	No		100% Other
66-2 MAS590583	1	Grey non-fibrous door caulking	No		100% Other
66-3 MAS590584	1	Grey non-fibrous door caulking	No		100% Other
67-1 MAS590585	1	Black fibrous felt paper	No		80% Cellulose 20% Asphalt
67-2 MAS590586	1	Black fibrous felt paper	No		80% Cellulose 20% Asphalt
67-3 MAS590587	1	Black fibrous felt paper	No		80% Cellulose 20% Asphalt
68-1 MAS590588	1	Grey non-fibrous glaze putty	No		100% Other
68-2 MAS590589	1	Black non-fibrous glaze putty	No		100% Other
68-3 MAS590590	1	Grey non-fibrous glaze putty	No		100% Other
69-1 MAS590591	1	Tan non-fibrous caulking	No		100% Other

Samples have been analyzed by the EPA - 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, EPA - 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Material. The test results herein relate only to the sample submitted and analyzed. This report may only be reproduced in full with the approval of the Bulk Asbestos Laboratory of Micro Analytical Services (MAS). The above percentages are visual estimates of area percent. MAS is not responsible for any errors resulting from improper or incorrect sampling or shipping procedures. These samples will be retained for a period of 30 days. Accreditation by NVLAP in no way constitutes or implies product certification, approval, or endorsement by NIST. Some materials, especially floor tiles, contain asbestos fibers too thin to be detected by this method. NVLAP Lab Code: 200618 TDSHS License: 30-0341

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Page 3 of 4





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## Polarized Light Microscopy Analysis

EFI Global, Inc.  
2000 South Dairy Ashford, Suite 600  
Houston, Texas 77077

MAS Project #: 19413-00  
Date Received: 01/28/2025  
Date Analyzed: 01/29/2025

*Project Name:* Arnold MS

Field ID/ Lab ID	Layer #	Sample Description	Asbestos Detected? (Yes/No)	Asbestos Constituents (%)	Non-Asbestos Constituents (%)
69-2 MAS590592	1	White non-fibrous caulking	No		100% Other
69-3 MAS590593	1	Beige fibrous tectum with white paint	No		70% Cellulose 30% Other

Samples have been analyzed by the EPA - 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, EPA - 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Material. The test results herein relate only to the sample submitted and analyzed. This report may only be reproduced in full with the approval of the Bulk Asbestos Laboratory of Micro Analytical Services (MAS). The above percentages are visual estimates of area percent. MAS is not responsible for any errors resulting from improper or incorrect sampling or shipping procedures. These samples will be retained for a period of 30 days. Accreditation by NVLAP in no way constitutes or implies product certification, approval, or endorsement by NIST. Some materials, especially floor tiles, contain asbestos fibers too thin to be detected by this method. NVLAP Lab Code: 200618 TDSHS License: 30-0341

*Analyzed by:* Tony Dang

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Page 4 of 4



Micro Analytical Services, Inc. 11301 Richmond Ave. Suite K100B Houston Texas 77082 Phone (281) 497-4500 Fax (281) 497-4517

### Asbestos Bulk Sample Chain of Custody

Arnold MS

Company: EFI Global, Inc.	Contact: Kenneth Capps	Project Name: <del>Arnold MS</del>
Address: 2000 South Dairy Ashford Suite 600	Bill to: EFI Global	Project #: 029.07189
City: Houston	Email: Kenneth.Capps@efiglobal.com	Project #: <del>029.07189</del>
State/Zip: TEXAS, 77077	Rick.Anderson@efiglobal.com	PO #:
Phone: (832) 518-5145	Ginger.Denman@efiglobal.com	
Fax: (832) 518-5157	Date Collected: 1-20-25	MAS Project #: 19913

Turn around time (circle): Emergency 1-day 2-day 3-day 4-day 5-day Total # of samples 30  
 Positive stop YES or (NO)

Field ID	Sample Description	Sample Location	Comments
60-1	2x2 Gypsum Ceiling Panels	Kitchen Area	
-2	↓	↓	
-3	↓	↓	
61-1	Gray Sediment on Dust Collector	1/2 Shop Area	
-2	↓		
-3	↓		
62-1	Seam proofing	2012 Addition	
-2	↓	↓	
-3	↓	↓	
63-1	Dampproofing on CMU w/ Pink Granite		
-2	↓		
-3	↓		
64-1	Dampproofing in Extern Gypsum Sheathing		
-2	↓		
-3	↓		
65-1	Plaster Soffit		
-2	↓		
-3	↓		
66-1	Exterior Door Frame Caulkers	2012 Add 1976 Add	
-2	↓	↓	
-3	↓	↓	

(21)

Relinquished by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Received by: TONY DANG Date: 1/28/25 Time: 9:00 AM  
 Relinquished by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_  
 Received by: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_



## **APPENDIX A2**

# **PHOTOGRAPHS AND RENOVATION INFORMATION ARCHITECTURAL SCOPE OF WORK**

	
<p><b>Photo 01:</b> Arnold Middle School</p>	<p><b>Photo 02:</b> 2'x2' Pinhole ceiling panels - nonACM</p>
	
<p><b>Photo 03:</b> 2'x2' Fissure pinhole ceiling panels - nonACM</p>	<p><b>Photo 04:</b> Gray flooring with tan/yellow glue – nonACM</p>
	
<p><b>Photo 05:</b> 12" x 12" Beige and Gray vinyl floor tile with yellow mastic - nonACM.</p>	<p><b>Photo 06:</b> Carpet with glue – nonACM</p>



**Photo 07:** Dust collector with gray sealant - nonACM.



**Photo 08:** Tectum panels with felt paper and caulking - nonACM



**Photo 09:** Chilled and heating water piping on the roof - nonACM



**Photo 10:** Chilled and heating water piping on the roof - nonACM



**Photo 11:** Fireproofing in the boy's locker room - nonACM



**Photo 12:** Duct insulation, chilled water and heating water piping in the 2009 addition - nonACM



**Photo 13:** ACM black damp proofing applied to CMU block – Typical for older building construction



**Photo 14:** ACM transite panel above the entrance to the boys locker room



**Photo 15:** ACM texture located above the doorways/lockers of room 110-118



**Photo 16:** ACM black mastic on pipe insulation – debris above plaster furr downs.



**Photo 17:** ACM plaster/texture joint filler applied to precast concrete deck panels.



**Photo 18:** Precast concrete deck panels with ACM transite panels – above ceilings 1955 bldg.

**Arnold Middle School**

**All costs are shown in 2019 dollars. The cost of all work items after this date should be adjusted accordingly.**

Priority Code	Item #	Item Description	Classification	Discipline	Source
<b>Architecture</b>					
2	1	Replace paint booth to meet district standards	Renovation	Architecture	CA
2	2	Replace educational casework in all classrooms (excluding science labs) casework per District standards (include counter tops, workstations and sinks where applicable).	Casework	Architecture	CA
2	3	Replace ceiling with new acoustical lay-in ceiling tile and grid throughout facility.	Ceiling	Architecture	CA
2	4	Replace vinyl composite tile (VCT) and base throughout facility (include ACM abatement where applicable).	Flooring (carpet, tile, etc.)	Architecture	CA
2	5	Replace science lab/classroom casework per District standards (include chemical resistant counter tops, workstations and sinks).	Casework	Architecture	CA
2	6	Renovate Cafeteria (include new finishes, acoustical treatment, lighting)	Renovation	Architecture	CA
2	7	Renovate Athletic and PE locker room areas (include new finishes, lockers, benches, shower and restroom areas)	Renovation	Architecture	CA
2	8	Strip down and refinish floor in auxiliary gym.	Flooring (carpet, tile, etc.)	Architecture	CA
2	9	Strip down and refinish floor in competition gym.	Flooring (carpet, tile, etc.)	Architecture	CA
2	10	Add 1,000 total to orchestra for the following: Increase main classroom size to 1,600 SF Add one (1) Ensemble room 500 SF Add one (1) Practice room 100 SF	Renovation	Architecture	DP
2	11	Provide new/additional acoustical wall treatments at band, choir, and orchestra (includes AWP, ceiling diffusers, sound seals, etc.).	Acoustical Treatment	Architecture	CA
2	12	Paint all previously painted interior surfaces. Repair/patch walls prior to painting.	Painting	Architecture	CA
2	13	Renovate corridor to provide new durable surfaces throughout (remove existing lockers, floor, ceiling, and include ACM abatement where applicable).	Renovation	Architecture	CA
2	14	Provide outside storage for football and track equipment.	Athletic Equip	Architecture	DP
2	15	Provide restrooms near performance gym	Renovation	Architecture	PQI
2	16	Add acoustical treatment at Theater Arts 918	Acoustical Treatment	Architecture	CA
2	17	Art 922 - Replace millwork	Millwork	Architecture	CA
2	18	Renovate Orchestra room to District Standards	Renovation	Architecture	DP
<b>Athletics/ Activities</b>					
2	19	Replace existing epoxy floor finish in locker rooms.	Flooring (carpet, tile, etc.)	Athletics/ Activities	CA
2	20	Provide retractable bleachers	Athletic Equip	Athletics/ Activities	CA
<b>Civil</b>					
1	21	Replace main sanitary sewer line outside of building.	Site Utilities	Civil	DP
2	22	Remove and replace pavement joint sealant	Site Paving - Maintenance	Civil	CA
<b>Electrical</b>					
1	23	Replace existing switchgear	Electrical Distribution	Electrical	CA
1	24	Provide generator backed power for all racks in all telecommunications rooms	Emergency Generator	Electrical	DP
2	25	Replace interior Lights with LED	Lighting (Interior)	Electrical	CA
2	26	Provide interior lighting controls.	Lighting (Interior)	Electrical	CA
2	27	Update cafeteria stage lighting, sound, A/V equipment and drapery packages	Lighting (Interior)	Electrical	PQI
2	28	Replace Competition gym sound system	Audio/Visual/ Sound	Electrical	CA
2	29	Replace Practice gym sound system	Audio/Visual/ Sound	Electrical	CA



**Arnold Middle School**

*All costs are shown in 2019 dollars. The cost of all work items after this date should be adjusted accordingly.*

Priority Code	Item #	Item Description	Classification	Discipline	Source
<b>Life Safety &amp; Security</b>					
1	30	Replace fire alarm	Fire Alarm System	Life Safety & Security	CA
2	31	Provide new marquee sign located at front entry per District standards.	Signage/ Way-finding	Life Safety & Security	CA
<b>Mechanical</b>					
1	32	Replace piping insulation and clean interior of roof-mounted air handling units, including coils, drain pans, and drain line.	HVAC	Mechanical	CA
1	33	Provide sub-metering for kitchen electrical, cooling/heating and water usages.	HVAC	Mechanical	DP
1	34	Add dedicated HVAC unit to secondary telecommunications rooms (IDF	HVAC	Mechanical	DP
2	35	Replace dust collector	HVAC	Mechanical	CA
2	36	Replace existing Sellers boiler	HVAC	Mechanical	CADP
2	37	Replace HVAC controls	HVAC	Mechanical	DP
2	38	Replace A/C units (A side and B side) at Portable Building #93	HVAC	Mechanical	DP
2	39	Replace A/C units (A side and B side) at Portable Building #121	HVAC	Mechanical	DP
2	40	Replace A/C units (A side and B side) at Portable Building #176	HVAC	Mechanical	DP
2	41	Replace A/C units (A side and B side) at Portable Building #191	HVAC	Mechanical	DP
<b>Plumbing</b>					
1	42	Repair gas piping on roof. Remove surface rust and paint. Replace all gas valves on roof (valves have corroded).	Plumbing - Gas Piping	Plumbing	CA
1	43	Replace problem site sanitary at front of building.	Plumbing - Sanitary Sewer	Plumbing	DP
2	44	Separate irrigation meter from existing water meter	Irrigation	Plumbing	DP
<b>Technology</b>					
2	45	Replace all existing data cables to Cat 6A	Technology - General/Misc.	Technology	CA
<b>Security</b>					
1	46	Additional card readers on exterior doors	Security	Security	DP
1	47	Harden main front desk	Security	Security	DP
1	48	Upgrade existing metal detectors	Security	Security	DP
1	49	Upgraded intrusion detection panels and door prop alarms	Security	Security	DP
2	50	Additional lockdown buttons	Security	Security	DP
2	51	Enhanced Video Intercoms	Security	Security	DP
2	52	Exterior Window and Door Numbering	Security	Security	DP
2	53	Fencing around portable buildings.	Security	Security	DP
2	54	Provide Classroom Phone	Security	Security	DP
2	55	Impact-resistant glass on doors and high-traffic areas	Security	Security	DP
2	56	Upgrade classroom and exterior door hardware	Security	Security	DP

Work performed or to be performed in a separate project

**APPENDIX A3**

**DRAWINGS WITH  
BULK SAMPLE LOCATIONS**















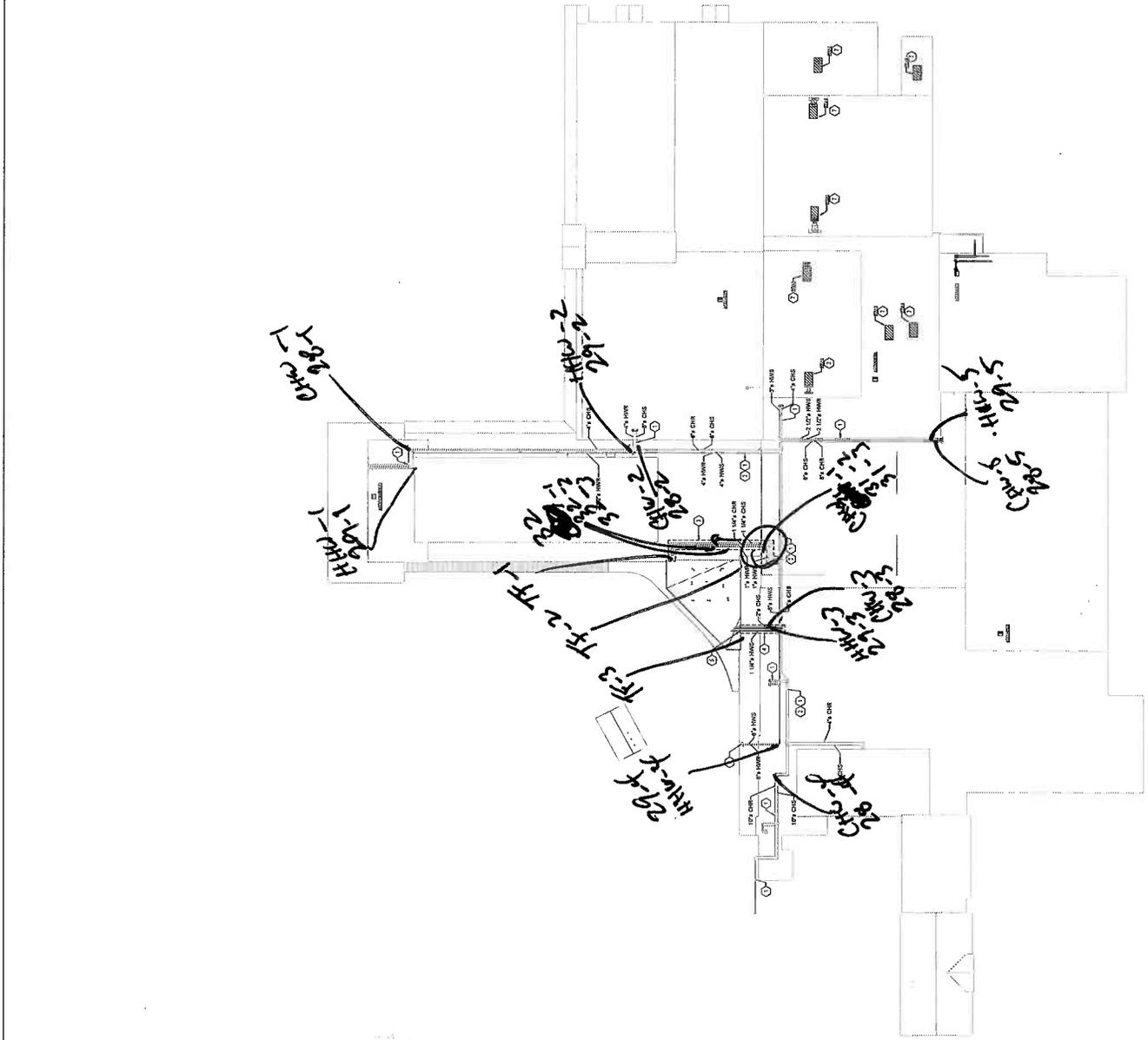








75% CD



**KEYED NOTES:**

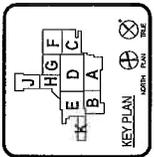
1. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
2. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
3. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
4. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
5. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
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7. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
8. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
9. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.
10. PROVIDE ALL MECHANICAL ROOF PENETRATIONS WITH AN ANCHORED STEEL PIPE AND ASSOCIATED PIPE ROOF SUPPORT TO MATCH EXISTING PENETRATIONS.



NO.	DESCRIPTION	DATE
1	ISSUED FOR PERMIT	11/11/2022
2	ISSUED FOR PERMIT	11/11/2022
3	ISSUED FOR PERMIT	11/11/2022
4	ISSUED FOR PERMIT	11/11/2022
5	ISSUED FOR PERMIT	11/11/2022
6	ISSUED FOR PERMIT	11/11/2022
7	ISSUED FOR PERMIT	11/11/2022
8	ISSUED FOR PERMIT	11/11/2022
9	ISSUED FOR PERMIT	11/11/2022
10	ISSUED FOR PERMIT	11/11/2022



11111 TRALEE RD  
CYPRESS, TX 77429  
7755 CD  
Arnold Middle School  
CYPRESS FAIRBANKS  
11111 TRALEE RD  
CYPRESS, TX 77429  
7755 CD



THIS DOCUMENT IS PREPARED FOR THE PURPOSE OF INTERNAL USE ONLY. IT IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF THE ENGINEER OF RECORD.

NO.	DESCRIPTION	DATE
1	ISSUED FOR PERMIT	11/11/2022
2	ISSUED FOR PERMIT	11/11/2022
3	ISSUED FOR PERMIT	11/11/2022
4	ISSUED FOR PERMIT	11/11/2022
5	ISSUED FOR PERMIT	11/11/2022
6	ISSUED FOR PERMIT	11/11/2022
7	ISSUED FOR PERMIT	11/11/2022
8	ISSUED FOR PERMIT	11/11/2022
9	ISSUED FOR PERMIT	11/11/2022
10	ISSUED FOR PERMIT	11/11/2022

MECHANICAL ROOF PLAN

M-301



## **APPENDIX A4**

### **CERTIFICATIONS AND LICENSE**



**TEXAS**  
Health and Human  
Services

Texas Department of State  
Health Services

**Asbestos Individual Consultant**

**SAM HUNTER HUFF**

**License Number: 105902**

**Control Number: 98468**

**Expiration Date: 25-Oct-2026**



**Texas Department of  
State Health Services**

**Asbestos Individual Consultant**

**KENNETH A CAPPS**

**License No. 105850**

**Control No. 98161**

**Expiration Date: 23-Jan-2025**







## Texas Department of State Health Services

**EFI GLOBAL INC**

*is certified to perform as an*

**Asbestos Consultant Agency**

*in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1954 and Title 12, Texas Administrative Code, Chapter 295 relating to Texas Asbestos Health Protection, as long as this license is not suspended or revoked.*



**License Number: 100409**

**Expiration Date: 04/26/2026**

**Control Number: 97653**

  
**Jennifer Shuford, MD, MPH,**  
**Commissioner of Health**

**(Void After Expiration Date)**

VOID IF ALTERED NON-TRANSFERABLE

SEE BACK

Issue for Proposal



Texas Department of State Health Services

MICRO ANALYTICAL SERVICES INC

*is certified to perform as an*

Asbestos Laboratory

PCM, PLM

*in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1954 and Title 12, Texas Administrative Code, Chapter 295 relating to Texas Asbestos Health Protection, as long as this license is not suspended or revoked.*

*License Number: 300341*

*Expiration Date: 01/25/2026*

*Control Number: 96774*

  
*Jennifer Shuford, MD, MPH,*  
*Commissioner of Health*

*(Void After Expiration Date)*

VOID IF ALTERED NON-TRANSFERABLE

SEE BACK

Issue for Proposal

United States Department of Commerce  
National Institute of Standards and Technology



---

# Certificate of Accreditation to ISO/IEC 17025:2017

---

NVLAP LAB CODE: 200618-0

**Micro Analytical Services, Inc.**

Houston, TX

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,  
listed on the Scope of Accreditation, for:*

## **Asbestos Fiber Analysis**

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.  
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality  
management system (refer to joint ISO-ILAC-IAF Communiqué on ISO/IEC 17025).*

2025-01-01 through 2025-12-31

*Effective Dates*

---



A handwritten signature in blue ink, appearing to read 'Peter S. Lamm', written over a horizontal line.

*For the National Voluntary Laboratory Accreditation Program*



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**GEOTECHNICAL ENGINEERING STUDY**

**FOR**

**ARNOLD MIDDLE SCHOOL (MS) ADDITIONS AND RENOVATIONS  
11111 TELGE ROAD  
CYPRESS, TEXAS 77429**

---



**LEGEND**

- ⊗ BORING
- ▭ PROPOSED BUILDING
- ▭ PROPOSED BUILDING ADDITION

0 87.5 175  
FEET  
1 inch = 175 feet

**RABA KISTNER**

3602 Westchase Drive  
Houston, TX 77042  
(713)996-8990 TEL  
(713)996-8993 FAX  
[www.rkci.com](http://www.rkci.com)  
TBPE Firm Number 3257

World Street Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

**BORING LOCATION MAP**  
Arnold Middle School (MS)  
Additions and Renovations  
11111 Telge Road  
Cypress, Texas 77429

HARRIS COUNTY

PROJECT No.: AHA24-053-00

ISSUE DATE:	12/17/2024
DRAWN BY:	BM
CHECKED BY:	JN
REVIEWED BY:	PTT

**FIGURE 1**

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes



**LOG OF BORING NO. B-1**  
 Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, TX



**DRILLING METHOD:** Straight Flight Auger & Mud Rotary

**LOCATION:** N 29.93979; W 95.65104

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>				PLASTICITY INDEX	% -200	
						0.5	1.0	1.5	2.0			2.5
			SURFACE ELEVATION: 139 ft									
			LEAN CLAY w/ SAND (CL), hard, brown and gray									
45			SANDY LEAN CLAY (CL), very stiff to hard, gray and brown	114							50	
50												
55			SILTY, CLAYEY SAND (SC-SM), medium dense to very dense, reddish brown	41							4	17
60				53								
65				29								23
70			SANDY FAT CLAY (CH), hard, reddish brown	46								
			Boring terminated at a depth of about 70 ft.									
75			NOTES: 1. Free water was encountered at a depth of 40.2 ft during drilling, the water level rose to the 38.8 ft depth 15 minutes after the initial reading. 2. The borehole was backfilled with soil cuttings and bentonite chips.									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

<b>DEPTH DRILLED:</b> 70.0 ft	<b>DEPTH TO WATER:</b> 38.8 ft	<b>PROJ. No.:</b> AHA24-053-00
<b>DATE DRILLED:</b> 11/25/2024	<b>DATE MEASURED:</b> 11/25/2024	<b>FIGURE:</b> 2b

# LOG OF BORING NO. B-2

Arnold Middle School (MS) Additions and Renovations  
11111 Telge Road  
Cypress, TX



**DRILLING METHOD:** Straight Flight Auger & Mud Rotary

**LOCATION:** N 29.93975; W 95.65121

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>				PLASTICITY INDEX	% -200	
						0.5	1.0	1.5	2.0			2.5
						PLASTIC LIMIT      WATER CONTENT      LIQUID LIMIT ---X---      ●      ---X--- 10      20      30      40      50      60      70      80						
SURFACE ELEVATION: 139 ft												
0 - 0.5			CONCRETE - 8 INCHES									
0.5 - 5			SILTY SAND (SM), dark brown									
5 - 11.7			CLAYEY SAND (SC), dark brown	117							NP	42
11.7 - 19			POORLY GRADED SAND w/ SILT (SP-SM), medium dense, brown and gray	19								
19 - 25				25								10
25 - 27			LEAN CLAY w/ SAND (CL), firm to stiff, reddish brown	14								
27 - 30												
30 - 35				116							17	73
35 - 40			SANDY LEAN CLAY (CL), hard, reddish brown									
40 - 46.7											26	58

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

<b>DEPTH DRILLED:</b> 70.0 ft	<b>DEPTH TO WATER:</b> 40.7 ft	<b>PROJ. No.:</b> AHA24-053-00
<b>DATE DRILLED:</b> 11/25/2024	<b>DATE MEASURED:</b> 11/25/2024	<b>FIGURE:</b> 3a



**LOG OF BORING NO. B-2**  
 Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, TX



**DRILLING METHOD:** Straight Flight Auger & Mud Rotary

**LOCATION:** N 29.93975; W 95.65121

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>				PLASTICITY INDEX	% -200	
						0.5	1.0	1.5	2.0			2.5
			SURFACE ELEVATION: 139 ft									
45			SANDY LEAN CLAY (CL), hard, reddish brown									
50			SILTY SAND (SM), dense to very dense, gray and brown									24
55				73								
60				41								
65			FAT CLAY w/ SAND (CH), stiff to very stiff, reddish brown	104								49
70			Boring terminated at a depth of about 70 ft.									
75			NOTES: 1. Free water was encountered at a depth of 42.2 ft during drilling, the water level rose to the 40.7 ft depth 15 minutes after the initial reading. 2. The borehole was backfilled with soil cuttings and bentonite chips.									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

<b>DEPTH DRILLED:</b> 70.0 ft	<b>DEPTH TO WATER:</b> 40.7 ft	<b>PROJ. No.:</b> AHA24-053-00
<b>DATE DRILLED:</b> 11/25/2024	<b>DATE MEASURED:</b> 11/25/2024	<b>FIGURE:</b> 3b

**LOG OF BORING NO. B-3**  
 Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, TX



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** N 29.93875; W 95.65085

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>							PLASTICITY INDEX	% -200		
						0.5	1.0	1.5	2.0	2.5	3.0	3.5			4.0	
			SURFACE ELEVATION: 138 ft													
0-5			CLAYEY SAND (SC), loose to medium dense, dark brown and gray -w/ roots to 2 ft	18		●	×	×	◇	●					11	49
5-8				8		●										34
8-11				114		×	◇	×	×						20	49
11-17			SANDY LEAN CLAY (CL), stiff to very stiff, light brown			●		◇	●							
17-19				17		●	×	×							4	14
19-20			SILTY, CLAYEY SAND (SC-SM), medium dense to very dense, light brown	19		●										
20-30				60		●										13
30-35			Boring terminated at a depth of about 30 ft.													
			NOTES: 1. Free water was not encountered. 2. The borehole was backfilled with soil cuttings and bentonite chips.													
<b>DEPTH DRILLED:</b> 30.0 ft				<b>DEPTH TO WATER:</b> dry				<b>PROJ. No.:</b> AHA24-053-00								
<b>DATE DRILLED:</b> 11/26/2024				<b>DATE MEASURED:</b> 11/26/2024				<b>FIGURE:</b> 4								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

# LOG OF BORING NO. B-4

Arnold Middle School (MS) Additions and Renovations  
11111 Telge Road  
Cypress, TX



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** N 29.94167; W 95.65069

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>				PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0		
			SURFACE ELEVATION: 137 ft								
			SANDY LEAN CLAY (CL), stiff to hard, dark brown -w/ roots to 2 ft							8	50
5			CLAYEY SAND (SC), dark brown		118					11	43
10			SANDY LEAN CLAY (CL), stiff, dark brown		9					21	60
15											
20			SILTY, CLAYEY SAND (SC-SM), medium dense to very dense, light brown		15						13
25					52						
30			Boring terminated at a depth of about 30 ft.		26						
35			NOTES: 1. Free water was not encountered. 2. The borehole was backfilled with soil cuttings and bentonite chips.								

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

<b>DEPTH DRILLED:</b> 30.0 ft	<b>DEPTH TO WATER:</b> dry	<b>PROJ. No.:</b> AHA24-053-00
<b>DATE DRILLED:</b> 11/26/2024	<b>DATE MEASURED:</b> 11/26/2024	<b>FIGURE:</b> 5

**LOG OF BORING NO. B-5**  
 Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, TX



**DRILLING METHOD:** Straight Flight Auger

**LOCATION:** N 29.93963; W 95.65036

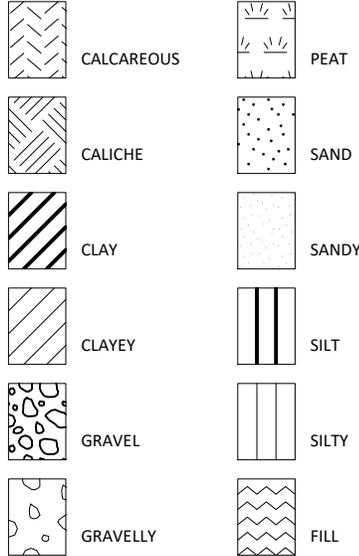
DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT <sup>2</sup>				PLASTICITY INDEX	% -200		
						0.5	1.0	1.5	2.0			2.5	3.0
			SURFACE ELEVATION: 139 ft										
			CONCRETE - 6 INCHES										
			SILTY SAND (SM), loose to medium dense, dark brown	14			●	⊗				3	41
				6			●						
5			SANDY LEAN CLAY (CL), stiff, gray and gray	11			●						
							●						
							●						
10			Boring terminated at a depth of about 10 ft.				●	◇					
			NOTES: 1. Free water was not encountered. 2. The borehole was backfilled with soil cuttings and bentonite chips.										
15													
20													
25													
30													
35													
<b>DEPTH DRILLED:</b> 10.0 ft			<b>DEPTH TO WATER:</b> dry			<b>PROJ. No.:</b> AHA24-053-00							
<b>DATE DRILLED:</b> 11/26/2024			<b>DATE MEASURED:</b> 11/26/2024			<b>FIGURE:</b> 6							

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

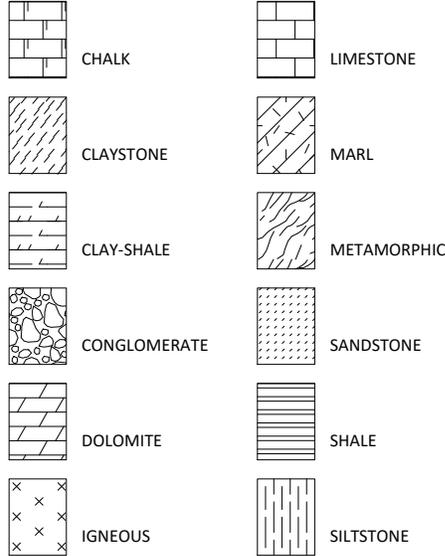
# KEY TO TERMS AND SYMBOLS

## MATERIAL TYPES

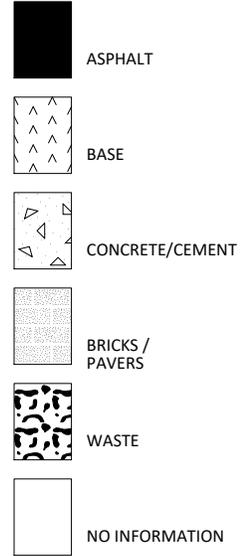
### SOIL TERMS



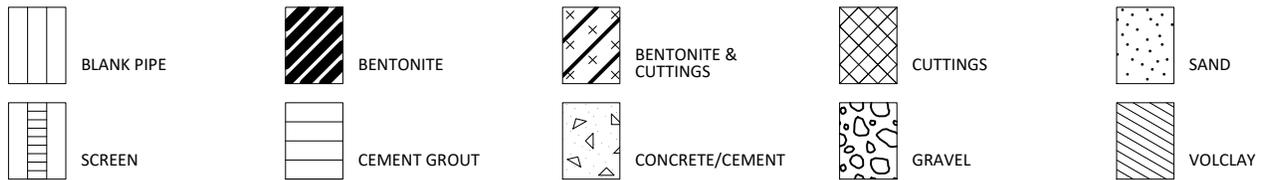
### ROCK TERMS



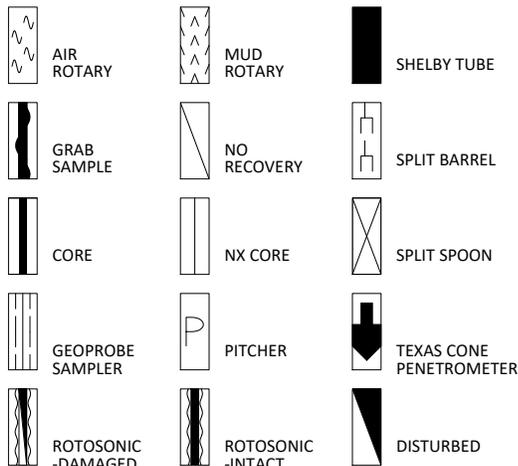
### OTHER



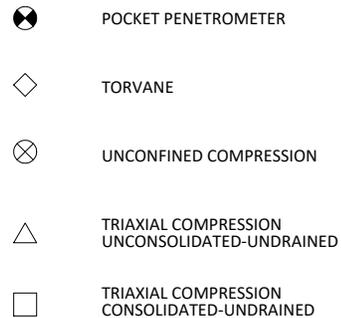
## WELL CONSTRUCTION AND PLUGGING MATERIALS



## SAMPLE TYPES



## STRENGTH TEST TYPES



NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

## KEY TO TERMS AND SYMBOLS (CONT'D)

### TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

#### RELATIVE DENSITY

#### COHESIVE STRENGTH

#### PLASTICITY

<u>Penetration Resistance Blows per ft</u>	<u>Relative Density</u>	<u>Resistance Blows per ft</u>	<u>Consistency</u>	<u>Cohesion TSF</u>	<u>Plasticity Index</u>	<u>Degree of Plasticity</u>
0 - 4	Very Loose	0 - 2	Very Soft	0 - 0.125	0 - 5	None
4 - 10	Loose	2 - 4	Soft	0.125 - 0.25	5 - 10	Low
10 - 30	Medium Dense	4 - 8	Firm	0.25 - 0.5	10 - 20	Moderate
30 - 50	Dense	8 - 15	Stiff	0.5 - 1.0	20 - 40	Plastic
> 50	Very Dense	15 - 30	Very Stiff	1.0 - 2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

### ABBREVIATIONS

B = Benzene	Qam, Qas, Qal = Quaternary Alluvium	Kef = Eagle Ford Shale
T = Toluene	Qat = Low Terrace Deposits	Kbu = Buda Limestone
E = Ethylbenzene	Qbc = Beaumont Formation	Kdr = Del Rio Clay
X = Total Xylenes	Qt = Fluvial Terrace Deposits	Kft = Fort Terrett Member
BTEX = Total BTEX	Qao = Seymour Formation	Kgt = Georgetown Formation
TPH = Total Petroleum Hydrocarbons	Qle = Leona Formation	Kep = Person Formation
ND = Not Detected	Q-Tu = Uvalde Gravel	Kek = Kainer Formation
NA = Not Analyzed	Ewi = Wilcox Formation	Kes = Escondido Formation
NR = Not Recorded/No Recovery	Emi = Midway Group	Kew = Walnut Formation
OVA = Organic Vapor Analyzer	Mc = Catahoula Formation	Kgr = Glen Rose Formation
ppm = Parts Per Million	EI = Laredo Formation	Kgru = Upper Glen Rose Formation
	Kknm = Navarro Group and Marlbrook Marl	Kgrl = Lower Glen Rose Formation
	Kpg = Pecan Gap Chalk	Kh = Hensell Sand
	Kau = Austin Chalk	

# KEY TO TERMS AND SYMBOLS (CONT'D)

## TERMINOLOGY

### SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

## SAMPLING METHODS

### RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

### STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

### SPLIT-BARREL SAMPLER DRIVING RECORD

<u>Blows Per Foot</u>	<u>Description</u>
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

# RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, TX

12/18/2024

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 2.0		12	17	13	4	SC-SM		46	0.30	TV
	2.0 to 4.0		15					117		0.79	UC
	4.0 to 6.0		15	34	13	21	CL		53	1.00	TV
	6.0 to 8.0		14							0.90	TV
	8.0 to 10.0		13							1.00	TV
	13.5 to 15.0	16	9						13		
	18.5 to 20.0	42	6								
	23.5 to 25.0	34	34								
	28.0 to 30.0		15	37	14	23	CL	120	77	3.48	UU
	33.0 to 35.0		12							1.50	TV
	38.0 to 40.0		12							2.50	TV
	43.0 to 45.0		17					114	50	2.14	UU
	48.0 to 50.0		16							1.25	TV
	53.5 to 55.0	41	21	18	14	4	SC-SM		17		
	58.5 to 60.0	53	21								
	63.5 to 65.0	29	20						23		
	68.5 to 70.0	46	24								
	B-2	0.0 to 2.0		12							
2.0 to 4.0			11			NP	SM		42	0.25	PP
4.0 to 6.0			15							0.70	TV
6.0 to 8.0			14	37	13	24	SC	117	47	0.49	UC
8.0 to 10.0			15							1.00	TV
13.5 to 15.0		19	12								
18.5 to 20.0		25	8						10		
23.5 to 25.0		14	31								
28.0 to 30.0			14	30	13	17	CL		73	0.80	TV
33.0 to 35.0			15					116		0.92	UU
38.0 to 40.0			19	42	16	26	CL		58	2.25	TV
43.0 to 45.0			16							1.25	TV
48.0 to 50.0			23						24		
53.5 to 55.0		73	15								
58.5 to 60.0		41	18								
63.0 to 65.0			23	69	20	49		104		0.94	UU
68.0 to 70.0			23							1.25	TV
B-3		0.0 to 2.0		9	24	13	11	SC		49	1.75
	2.5 to 4.0	18	5						34		
	4.5 to 6.0	8	17								
	6.0 to 8.0		15	33	13	20	SC	114	49	0.55	UC
	8.0 to 10.0		15							1.25	TV

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Van UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

PROJECT NO. AHA24-053-00

**RABAKISTNER**

FIGURE 8a

Issue for Proposal



# RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, TX

12/18/2024

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-3	13.0 to 15.0		15							0.90	TV
	18.5 to 20.0	17	11	23	19	4	SC-SM		14		
	23.5 to 25.0	19	14								
	28.5 to 30.0	60	8						13		
B-4	0.0 to 2.0		11	21	13	8	SC		50	1.00	TV
	2.0 to 4.0		11							2.50	TV
	4.0 to 6.0		12	23	12	11	SC	118	43	0.76	UC
	6.0 to 8.0		16							1.25	TV
	8.5 to 10.0	9	13	33	12	21	CL		60		
	13.0 to 15.0		14							0.70	TV
	18.5 to 20.0	15	6						13		
	23.5 to 25.0	52	20								
B-5	28.5 to 30.0	26	15								
	0.5 to 2.0	14	14	18	15	3	SM		41		
	2.5 to 4.0	6	15								
	4.5 to 6.0	11	16								
	6.0 to 8.0		16							0.80	TV
	8.0 to 10.0		15							1.00	TV

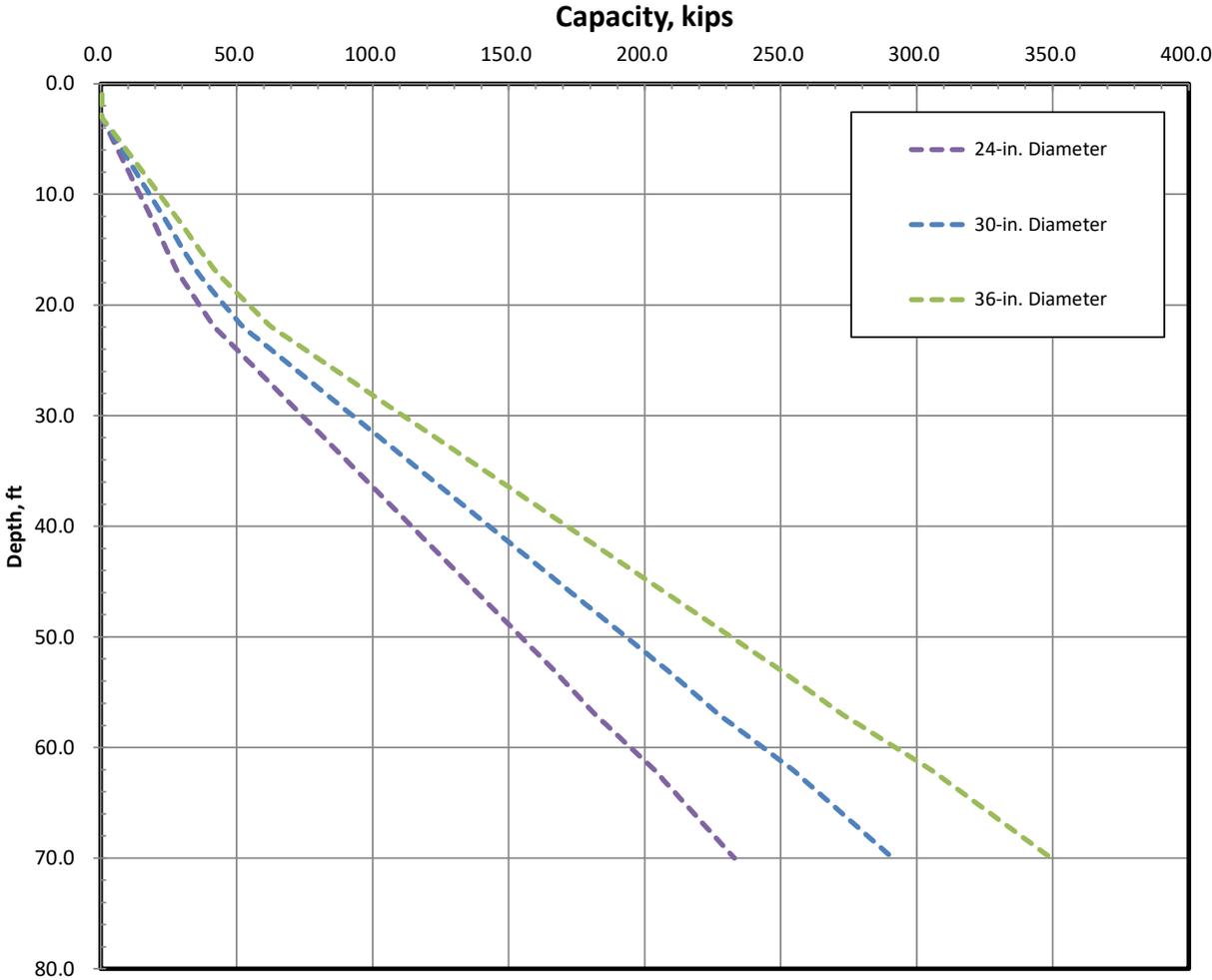
PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial  
 CU = Consolidated Undrained Triaxial

PROJECT NO. AHA24-053-00



FIGURE 8b

# Allowable Axial Capacity Curves - Tension For Augered Cast-in-Place Piles



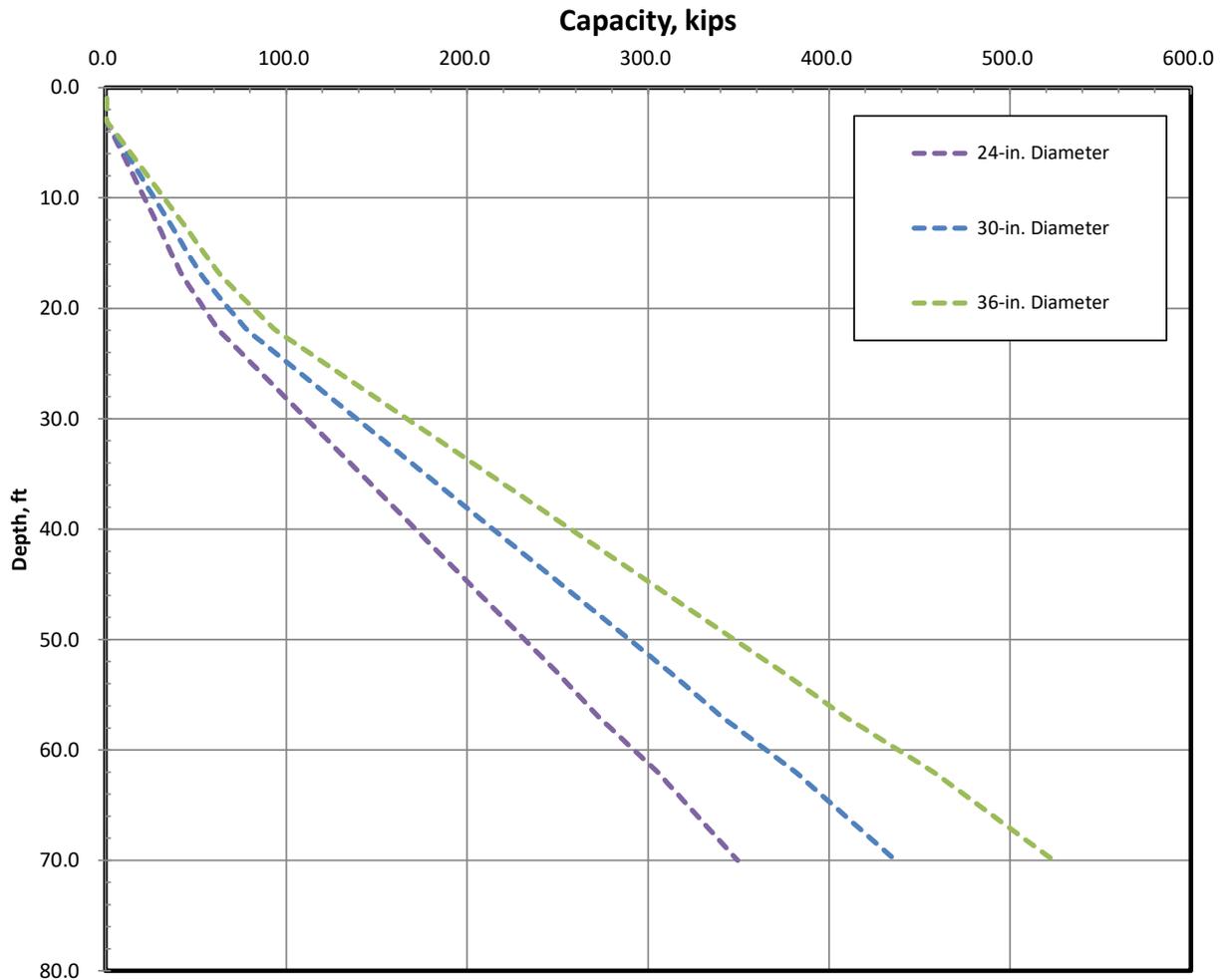
- Notes:
1. Reference: FHWA-HIF-07-03 / FHWA -NHI-10-016.
  2. Allowable Stress Design: Factor of Safety (SF) = 3 for Tension.
  3. Side resistance from upper 3 ft depth disregarded to account for possible disturbance during construction and possible surface scour of the cohesionless soils due to surface water flow.
  4. Chart is for estimation purposes only. Additional information is required for final design including ground elevation at final grade.



Axial Capacity Chart for Augered Cast-in-Place Piles  
 Arnold Middle School (MS) Additions and Renovations  
 11111 Telge Road  
 Cypress, Texas 77429

Figure 9

## Allowable Axial Capacity Curves - Compression For Augered Cast-in-Place Piles



**Notes:**

1. Reference: FHWA-HIF-07-03 / FHWA -NHI-10-016.
2. Allowable Stress Design: Factor of Safety (SF) = 2 for Compression.
3. Side resistance from upper 3 ft depth disregarded to account for possible disturbance during construction and possible surface scour of the cohesionless soils due to surface water flow.
4. Chart is for estimation purposes only. Additional information is required for final design including ground elevation at final grade.



**Axial Capacity Chart for Augered Cast-in-Place Piles**  
**Arnold Middle School (MS) Additions and Renovations**  
**11111 Telge Road**  
**Cypress, Texas 77429**

**Figure 10**

# Important Information about This

# Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

## A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

### **Do Not Redraw the Engineer's Logs**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

### **Give Constructors a Complete Report and Guidance**

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

### **Read Responsibility Provisions Closely**

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

### **Environmental Concerns Are Not Covered**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

### **Obtain Professional Assistance To Deal with Mold**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

### **Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance**

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



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## **SECTION 01 22 00**

### **MEASUREMENT AND PAYMENT (UNIT PRICES)**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### **PART 1 - GENERAL**

Refer to Document AB for Substitutions of Materials and Equipment

##### **1.1 SECTION INCLUDES**

- A. Measurement and payment criteria applicable to portions of the Work performed under a unit price payment method.
- B. Defect assessment and non-payment for rejected work.

##### **1.2 AUTHORITY**

- A. Measurement methods delineated in the individual specification sections complement the criteria of this Section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. The Architect will verify measurements and quantities.

##### **1.3 UNIT QUANTITIES SPECIFIED**

- A. Quantities indicated in the Contract Documents are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Architect determine payment.
- B. If the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum/prices contracted.

##### **1.4 MEASUREMENT OF QUANTITIES**

- A. Measurement Devices:
  - 1. Weigh Scales: Inspected, tested, and certified by the applicable State Weights and Measures Department within the past year.
  - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
  - 3. Metering Devices: Inspected, tested, and certified by the applicable State department within the past year.
- B. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- C. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- D. Measurement by Area: Measured by square dimension using mean length and width or radius.
- E. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- F. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

## **1.5 PAYMENT**

- A. Payment Includes: Full compensation for all required labor, labor burden, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.
- B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities confirmed and accepted by the Architect multiplied by the unit/sum price for work which is incorporated in or made necessary by the Work.

## **1.6 DEFECT ASSESSMENT**

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.
- C. The authority of the Architect to assess the defect and identify payment adjustment is final.

## **1.7 NON-PAYMENT FOR REJECTED PRODUCTS**

- A. Payment will not be made for any:
  - 1. Products wasted or disposed of in a manner that is not acceptable.
  - 2. Products determined as unacceptable before or after placement.
  - 3. Products not completely unloaded from the transporting vehicle.
  - 4. Products placed beyond the lines and levels of the required work.
  - 5. Products remaining on hand after completion of the work.
  - 6. Loading, hauling and disposing of rejected Products.

## **PART 2 – DESCRIPTION OF UNIT PRICES**

### **2.1 GENERAL**

- A. For the work described unit pricing shall be used to determine the additional cost or credit to the contract amount or added to or deducted from the Owner’s contingency for changes in the scope of work made during the progress of the work as directed by Architect.
- B. The same price shall be used for adding or deducting from the scope of work. No exceptions.
- C. The following unit prices shall be included in the proposal form and shall be included in the Owner-Contractor agreement.

## **PART 3 - EXECUTION**

### **3.1 SCHEDULE OF UNIT PRICES**

- A. Unit Prices shall be used, where applicable, to make adjustments to the cost of the work due to changes. All Unit Prices submitted shall be complete “turnkey” prices for fully functioning systems, and shall include all costs for overhead, profit, labor, labor burden, material, equipment, and any other incidentals related to the completion of the Work and shall remain firm for the duration of the contract. Unit prices listed are for additive and/or deductive work.



**UNIT PRICE 1: REMOVAL OF UNSATISFACTORY SOIL AND REPLACEMENT WITH SATISFACTORY SOIL MATERIAL PER CUBIC YARD**

Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, according to Section 312000 "Earth Moving." Provide unit price for one cubic yard of soil excavated, based on survey of volume removed. Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances." Cost shall include all materials, labor, overhead and profit for complete installation satisfactory soil material.

**UNIT PRICE NO. 2: ROCK EXCAVATION AND REPLACEMENT WITH SATISFACTORY SOIL MATERIAL PER CUBIC YARD**

Classified rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, according to Section 312000 "Earth Moving." Provide unit price for one cubic yard of rock excavated, based on survey of volume removed. Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances." Cost shall include all materials, labor, overhead and profit for complete installation of satisfactory soil material.

**UNIT PRICE NO. 3: CUTTING AND PATCHING OF CONCRETE FLOOR SLABS PER SQUARE FOOT**

Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents. Provide a unit price for one square feet of concrete removed and replaced. Cost shall include all materials, labor, overhead and profit for complete installation of concrete floor slab.

**UNIT PRICE NO. 4: CEMENT STABILIZED SAND AND LEAN CONCRETE PER CUBIC YARD**

This unit price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for the complete installation of cement stabilized sand and lean concrete.

**UNIT PRICE NO. 5: SELECT FILL PER CUBIC YARD**

This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation of select fill.

**UNIT PRICE NO. 6: FLOWABLE FILL (CLSM) PER CUBIC YARD**

This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of flowable fill or controlled low-strength material (CLSM), delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation.

**UNIT PRICE NO. 7: CONCRETE**

This unit price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new concrete material, delivery, labor for installation/ placement, formwork, etc per plans and specs. Reinforcement for concrete shall also be included and shall be assumed to be 2% minimum by volume.

**UNIT PRICE NO. 8: GRADE BEAM (ADD)**

This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302.1. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam.

1.	GB1	\$_____ /	Foot
2.	GB2	\$_____ /	Foot
3.	GB3	\$_____ /	Foot
4.	GB4	\$_____ /	Foot
5.	GB5	\$_____ /	Foot
6.	GB6	\$_____ /	Foot
7.	GB7	\$_____ /	Foot
8.	GB8	\$_____ /	Foot
9.	GB10	\$_____ /	Foot
10.	GB16	\$_____ /	Foot

**UNIT PRICE NO. 9: GRADE BEAM (DEDUCT)**

This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam.

1.	GB1	\$_____ /	Foot
2.	GB2	\$_____ /	Foot
3.	GB3	\$_____ /	Foot
4.	GB4	\$_____ /	Foot
5.	GB5	\$_____ /	Foot
6.	GB6	\$_____ /	Foot
7.	GB7	\$_____ /	Foot
8.	GB8	\$_____ /	Foot
9.	GB10	\$_____ /	Foot
10.	GB16	\$_____ /	Foot

**UNIT PRICE NO. 10: DRILLED PIER (ADD)**

This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) drilled pier of each drilled pier size utilized in the project per 1/S-303. Cost shall include all materials, labor, detailing, overhead and profit for complete installation.

1.	24/48	\$ _____/	Added pier
2.	30/60	\$ _____/	Added pier
3.	36/72	\$ _____/	Added pier
4.	39/78	\$ _____/	Added pier
5.	45/90	\$ _____/	Added pier

**UNIT PRICE NO. 11: DRILLED PIER (DEDUCT)**

This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) drilled pier of each drilled pier size utilized in the project per 1/S-303. Cost shall include all materials, labor, detailing, overhead and profit for complete installation.

1.	24/48	\$ _____/	Removed pier
2.	30/60	\$ _____/	Removed pier
3.	36/72	\$ _____/	Removed pier
4.	39/78	\$ _____/	Removed pier
5.	45/90	\$ _____/	Removed pier

**UNIT PRICE NO. 12: PIER CASINGS:**

The contractor shall provide a unit price for net length of casing utilized for all pier types utilized on the project. Cost shall include all materials, labor, overhead and profit for complete installation.

1.	24/48	\$ _____/	Casing
2.	30/60	\$ _____/	Casing
3.	36/72	\$ _____/	Casing
4.	39/78	\$ _____/	Casing
5.	45/90	\$ _____/	Casing

**UNIT PRICE NO. 13: EXISTING PIER DEMO CONDITION 1 (OVERLAP WITH NEW PIER):**

At any location where a new pier will overlap an existing footing/pier, the soil currently in the existing footing/pier shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size.

1.	24/48	\$ _____/	Pier Demo Condition 1
2.	30/60	\$ _____/	Pier Demo Condition 1

3.	36/72	\$ _____/	Pier Demo Condition 1
4.	39/78	\$ _____/	Pier Demo Condition 1
5.	45/90	\$ _____/	Pier Demo Condition 1

**UNIT PRICE NO. 14: EXISTING PIER DEMO CONDITION 2 (NO CONFLICT WITH NEW PIERS):**

At any location where an existing footing/pier does not overlap with a new pier, the portion of the existing footing/pier within 4.5 ft of the bottom of the future slab shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698). The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size.

1.	24/48	\$ _____/	Pier Demo Condition 2
2.	30/60	\$ _____/	Pier Demo Condition 2
3.	36/72	\$ _____/	Pier Demo Condition 2
4.	39/78	\$ _____/	Pier Demo Condition 2
5.	45/90	\$ _____/	Pier Demo Condition 2

**UNIT PRICE NO. 15: MISCELLANEOUS AND STRUCTURAL STEEL PER POUND**

Miscellaneous steel, structural steel, and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications." This unit price shall be the entire unit cost including overhead and profit for one (1) pound of fabricated steel as indicated on the itemized invoice of steel supplier and verified by the Architect. Cost shall include all materials, labor, detailing, engineering, erection, overhead and profit for complete installation. Enter unit cost on the Proposal Form.

**Unit Price No. 14: Gypsum Board**

This unit price shall establish the cost for installing a 9'-0" by 5'0" section of drywall, with a 3 5/8 stud, floated and painted.

**Unit Price No. 15: Tile Backer Board**

This unit price shall establish the cost for installing a 9'-0" by 5'0" section of tile backer board, with 3 5/8" stud, and prepped for tile.

**END OF SECTION**

## SECTION 01 23 00

### ALTERNATES

#### PART 1 - GENERAL

##### 1.1 ALTERNATE PRICES

- A. Contractor shall state, in the spaces provided in the proposal form, Alternate Prices for the work described below. The responsibility of determining quantity of Alternates rests with the Contractor. Base Proposal and Alternates shall include cost of all supporting elements required, so that no matter what combination of Base Proposal and Alternates are accepted, that portion shall be a complete entity. Work for all Alternates shall be in strict accordance with the specification sections noted and applicable to the specific work.

#### PART 2 - PRODUCTS

Not Used

#### PART 3 - EXECUTION

##### 3.1 ALTERNATES

- A. **Alternate Number 1: Base Bid Adjustment**  
This alternate shall establish the adjustments to the General Contractor's Base Proposal submitted at 2:00 pm, if necessary. This alternate shall be accepted whether it is an add or a deduct and will be used as part of the evaluation process to determine the best value for the District.
- B. **Alternate Number 2: Lighting Controls by Wattstopper**  
This alternate shall establish the amount to be added to the Base Proposal for the Contractor to provide Lighting Controls as manufactured by Wattstopper as specified in section 26 09 43 and as indicated on the drawings.

##### 3.2 GENERAL NOTES

- A. Unless otherwise indicated, scope of work for each alternate shall include material and labor, general conditions and all other costs associated with completing the work described.
- B. Alternates are not listed in any order of priority.
- C. Acceptance of alternates shall be the sole discretion of the Owner.
- D. See Section AB for alternate pricing timelines.

END OF SECTION

**01 25 13.01 - REQUEST FOR SUBSTITUTION**

Contract Award Date: \_\_\_\_\_

To: \_\_\_\_\_

Substitution Requested By: \_\_\_\_\_

Project Name and Number: \_\_\_\_\_

We submit for consideration the following product in lieu of the specified item for the above project:

Drawing No.	Specification Section	Paragraph	Specified Item
_____	_____	_____	_____

Proposed Substitution: \_\_\_\_\_

Request is made during \_\_\_\_ bidding \_\_\_\_ construction period.

Submit in accordance with Section 01 33 00.

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

Cause for Request: \_\_\_\_\_

Cost saving realized by Owner \_\_\_\_\_

Does substitution affect adjacent Work, Construction Documents, cost, schedule, quality, and related submittals?

Yes \_\_\_\_ No \_\_\_\_ On separate sheet, explain affects to the Work, documents, schedule, and submittals.

The Contractor is responsible for associated costs and additional time of the proposed substitution including costs incurred by the Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by the requested substitution.

\_\_\_\_\_  
\_\_\_\_\_

Warranty: Is the warranty for the requested substitution the same or different? Yes \_\_\_\_ No \_\_\_\_

Explain Differences: \_\_\_\_\_

**Contractor Certification:**

In making a request for substitution, the Contractor certifies that:

1. The proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.
2. It will provide the same or better warranty for the proposed substitution at no additional cost to the Owner.

- 3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
- 4. It will assume the responsibility for delays and costs caused by the proposed substitution, if approved, are accepted by the Contractor unless delays are and costs are specifically mentioned and approved in writing by the Owner and the Architect.
- 5. It will assume the liability for the performance of the substitution and its performance.
- 6. The installation of the proposed substitution is coordinated with the Work and with changes required for the Work.
- 7. It will reimburse the Owner and Architect for evaluation and redesign services associated with the substitution request and, when required, by approval by governing authorities.

\_\_\_\_\_ Has the substituted manufacturer/product been installed on previous PBK projects?

**If so, list project(s):** (List projects within the last two years)

- 1. \_\_\_\_\_  
District: \_\_\_\_\_  
Contact: \_\_\_\_\_
- 2. \_\_\_\_\_  
District: \_\_\_\_\_  
Contact: \_\_\_\_\_

Submitted by:

\_\_\_\_\_  
Signature of Contractor Title

\_\_\_\_\_  
Firm Telephone Date

Signature shall be by the individual authorized to legally bind the Contractor's to the above terms. Failure to provide legally binding signature will result in retraction of approval.

**FOR USE BY ARCHITECT:**

**FOR USE BY OWNER:**

\_\_\_\_ Accepted      \_\_\_\_ Accepted as Noted  
\_\_\_\_ Not Accepted      \_\_\_\_ Received Too Late

\_\_\_\_ Accepted      \_\_\_\_ Not Accepted

By: \_\_\_\_\_ By: \_\_\_\_\_

Date: \_\_\_\_\_ By: \_\_\_\_\_

Remarks: \_\_\_\_\_ Remarks: \_\_\_\_\_

**END OF SECTION 01 25 13.01**

## SECTION 01 29 73

### SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.
- B. Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.

##### 1.2 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described. All calculations shall be to two (2) decimal places.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

##### 1.3 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed Schedule of Values to the Owner and Architect as outlined below:
  - 1. Meet with the Owner and Architect and determine additional data, if any, required to be submitted.
  - 2. Secure the Owner's approval of the Schedule of Values prior to submitting first Application for Payment.

##### 1.4 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum with materials and labor separated. After review by the Owner and Architect, the Schedule of Values shall be broken down into further items as required. (See following list).
- B. Schedule of Values: Refer to the following sample.
- C. Indicate page subtotals on each page of Schedule of Values.
- D. Each page to be printed single-sided.
- E. Schedule of Values is to be submitted for approval per AIA Document A101, Article 3.3

#### PART 2 – PRODUCTS

Not Used

#### PART 3 - EXECUTION

##### 3.1 SCHEDULE OF VALUES

- A. Refer to sample attached herein.



**SECTION 01 29 73  
SCHEDULE OF VALUES - SAMPLE**

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Matls	Total Completed	%
			Previous App.	This App.			
	<p><b><i>NOTE: IF PROJECT CONSISTS OF BOTH NEW ADDITION(S) AND REMODEL (S), EACH SHALL HAVE A SEPARATE SCHEDULE OF VALUES. Listing shall include but not be limited to:</i></b></p> <p><b>Div. 1 - General Conditions</b>            Sitework            Supervision            Mobilization            Contractor's Fee            General Conditions            Temp. Facilities            Project sign            Coordination drawings            Final Cleaning            As-Builts/Close-out/O&amp;M Manuals/Record Drawings            Permits            Bonds            Insurance            Contractor's written Punch List</p> <p><b>Div. 2 - Existing Conditions</b></p> <p><b>Div. 3 - Concrete</b>            Drilled Piers Matls            Drilled Piers Labor            Caps &amp; Beams Matls            Caps &amp; Beams Labor            Slab on Grade Matls            Slab on Grade Labor            Cooling Tower Basin Matls            Cooling Tower Basin Labor            Misc. Bldg Concrete Matls            Misc. Bldg Concrete Labor            Rebar Matls            Rebar Labor            Lt. Wt. Insul Fill - Matls            Lt. Wt. Insul Fill - Labor            Close-out Documents            Punch List</p>						

**Div. 4 - Masonry**

Brickwork - Matls  
Brickwork - Labor  
Concrete Masonry - Matls  
Concrete Masonry - Labor  
Str. Glazed Tile - Labor  
Str. Glazed Tile - Matls  
Masonry clean up/acid wash  
Close-out Documents  
Punch List

**Div. 5- Metals**

Structural Steel - Matls  
Structural Steel - Labor  
Misc. Steel - Matls  
  
Steel Joists - Matls  
  
Lt. Gauge Steel Framing - Matls  
Lt. Gauge Steel Framing - Labor  
Metal Decking - Matls  
Metal Decking - Labor  
Expansion Covers - Matls  
Expansion Covers - Labor  
Alternating Stairs Matls  
Alternating Stairs Labor  
Close-out Documents  
Punch List

**Div. 6 - Wood & Plastics**

Rough Carpentry - Matls  
Rough Carpentry - Labor  
Millwork - Matls  
Millwork - Labor

**Div. 7 - Thermal & Moisture Protection**

Waterproofing & Dampproofing Matls  
Waterproofing & Dampproofing Labor  
Building Insulation - Matls  
Building Insulation - Labor  
Fireproofing - Matls  
Fireproofing - Labor  
Metal Roof - Matls  
Metal Roof - Labor  
Metal Roof Guarantee  
Modified Bitumen Roofing Base Sheet- Matls  
Modified Bitumen Roofing Base Sheet - Labor  
Modified Bitumen Roofing Cap Sheet - Matls

Modified Bitumen Roofing Cap Sheet - Labor  
Modified Bitumen Roofing - Guarantee  
Building Sheet Metal - Matls  
Building Sheet Metal - Labor  
Bldg. Sheet Metal Guarantee  
Roof Curbs Matls  
Roof Curbs Labor  
Roof Hatches Matls  
Roof Hatches Labor  
Sealants Matls  
Sealants Labor  
Roof Accessories Matls  
Roof Accessories Labor  
Close-out Documents  
Punch List

**Div. 8 - Doors & Windows**

Finish Carpentry/Door - Matls  
Finish Carpentry/Door - Labor  
Finish Hardware - Matls  
Finish Hardware - Labor  
Thresholds & Seals Matls  
Thresholds & Seals Labor  
Hollow Metal Doors & Frames - Matls  
Hollow Metal Doors & Frames - Labor  
Plastic Faced Doors - Matls  
Plastic Faced Doors - Labor  
Overhead Doors & Grilles - Matls  
Overhead Doors & Grilles - Labor  
Alum. Entrances & Storefronts - Matls  
Alum. Entrances & Storefronts - Labor  
Alum. Windows - Matls  
Alum. Windows - Labor  
Glass & Glazing - Matls  
Glass & Glazing - Labor  
Glass & Glazing - water test  
Close-out Documents  
Punch List

**Div. 9 - Finishes**

Lath & Plaster - Matls  
Lath & Plaster - Labor  
Gypsum Wallboard Systems - Matls  
Gypsum Wallboard Systems - Labor  
Ceramic Tile - Matls  
Ceramic Tile - Labor  
Quarry Tile - Matls  
Quarry Tile - Labor  
Terrazzo - Matls

Terrazzo - Labor  
Acoustic Clg. - Matls  
Acoustic Clg. - Labor  
Acoustic Wall Panels - Matls  
Acoustic Wall Panels - Labor  
Resilient Flooring - Matls  
Resilient Flooring - Labor  
Carpet - Matls  
Carpet - Labor  
Athletic Flooring - Matls  
Athletic Flooring Labor  
Floor Sealer - Matls  
Floor Sealer - Labor  
Painting - Matls  
Paint - Labor  
Close-out Documents  
Punch List

**Div. 10 - Specialties**

Tackboards - Matls  
Tackboards - Labor  
Toilet Partitions - Matls  
Toilet Partitions - Labor  
Louvers - Matls  
Louvers - Labor  
Aluminum Flag Pole - Matls  
Aluminum Flag Pole - Labor  
Graphics -Matls  
Graphics -Labor  
Lockers Matls  
Lockers Labor  
Locker combinations in Excel format  
Demountable Partitions - Matls  
Demountable Partitions - Labor  
Metal Shelving Matls  
Metal Shelving Labor  
Scoreboards - Matls.  
Scoreboards - Labor  
Toilet Room Accessories - Matls  
Toilet Room Accessories - Labor  
Visual Display Boards - Matls  
Visual Display Boards - Labor  
Cubicle Curtains & Track - Matls  
Cubicle Curtains & Track - Labor  
Fire Extinguisher Cabinets Matls  
Fire Extinguisher Cabinets Labor  
Close-out Documents  
Punch List

**Div. 11 - Equipment**

Stage Curtains Matls  
Stage Curtains Labor  
Stage rigging Matls  
Stage rigging Labor  
Stage lighting Matls  
Stage lighting Labor  
Misc. Appliances Matls  
Misc. Appliances Labor  
Food Service - Submittals/coordination drawings  
Food Service - Walk-ins Matls  
Food Service - Walk-ins Labor  
Food Service - Flatwork - Matls  
Food Service - Flatwork - Labor  
Food Service Eqpt - Labor  
Food Service Eqpt - Matls  
Food Service - Close-out Documents  
Food Service - Training  
Food Service - Kitchen Hoods - Matls  
Food Service - Kitchen Hoods - Labor  
Food Service - Ansul Syst. - Matls  
Food Service - Ansul Syst. - Labor  
Close-out Documents  
Punch List

**Div. 12 - Furnishings**

Casework - Matls  
Casework - Labor  
Science Casework - Matls  
Science Casework - Labor  
Horizontal Blinds - Matls  
Horizontal Blinds - Labor  
Projection Screen - Matls  
Projection Screen - Labor  
Close-out Documents  
Punch List

**Div. 13 - Special Construction**

**Div. 14 - Conveying Systems**

Elevator - Matls  
Elevator - Labor  
Elevator - Maintenance Agreement

**Div. 21 - Fire Suppression**

Fire Sprinkler Syst. - Eng/Submittals  
Fire Sprinkler Syst. - Underground piping/Vault -  
Matls

Fire Sprinkler Syst. - Underground piping/Vault - Labor  
Fire Sprinkler Syst. - Above slab piping - Matls  
Fire Sprinkler Syst. - Above slab piping - Labor  
Fire Sprinkler Syst. - Trim-out - Matls  
Fire Sprinkler Syst. - Trim-out - Labor  
Fire Sprinkler Syst. - Start-up/Testing  
Fire Sprinkler Syst. - Close-out Documents  
Close-out Documents  
Punch List

**Div. 22 - Plumbing**

Shop Drawings  
Coordination Drawings  
As-Builts/Close-out O&M Manuals  
Sanitary Underground - Matls  
Sanitary Underground - Labor  
Storm Underground - Matls  
Storm Underground - Labor  
Domestic Water - Matls  
Domestic Water - Labor  
Plumbing Dissolution Matls  
Plumbing Dissolution Labor  
Gas Piping - Matls  
Gas Piping - Labor  
Grease Trap - Matls  
Grease Trap - Labor  
Fixtures - Matls  
Fixtures - Labor  
Rodding/Camera lines

**Div. 23 - Heating Ventilating and Air Conditioning**

Shop Drawings  
As-Builts/Close-out O&M Manuals  
Coordination drawings  
Chillers - Matls  
Chillers - Labor  
Cooling Towers - Matls  
Cooling Towers - Labor  
Boilers - Matls  
Boilers - Labor  
AHU's - Matls  
AHU's - Labor  
Fans - Matls  
Fans - Labor  
Grilles -Matls  
Grilles - Labor  
Ductwork - Matls

Ductwork - Labor					
Pumps - Matls					
Pumps - Labor					
Water Treatment - Matls					
Water Treatment - Labor					
Isolation - Matls					
Isolation - Labor					
Pipe Flex - Matls					
Pipe Flex - Labor					
Sheet Metal - Matls					
Sheet Metal - Labor					
Duct Insulation - Matls					
Duct Insulation - Labor					
Pipe Insulation - Matls					
Pipe Insulation - Labor					
Pipe, Valves, Fittings - Matls					
Pipe, Valves, Fittings - Labor					
Misc. - Labor					
Misc. - Matls					
Insulation - Matls					
Insulation - Labor					
Sanitary Above Slab - Matls					
Sanitary Above Slab - Labor					
Storm Above Slab - Labor					
Storm Above Slab - Matls					
Gas - Matls					
Gas - Labor					
Fixtures - Matls					
Fixtures - Labor					
Permits					
VAV Boxes - Matls					
VAV Boxes - Labor					
Refrigerant Monitor - Matls					
Refrigerant Monitor - Labor					
Unit Heaters - Matls					
Unit Heaters - Labor					
Startup					
<b>Controls</b>					
Eng/Submittals					
Valves/Dampers - Matls					
Valves/Dampers - Labor					
Box Controls - Matls					
Box Controls - Labor					
Modules -Matls					
Modules -Labor					
End Devices - Matls					
End Devices - Labor					
Low Voltage Wiring - Matls					

Low Voltage Wiring - Labor  
Startup/commissioning  
Software Installation/Graphics upload to CFISD server  
Close-out Documents  
Training  
Punch List

**Div. 26 - Electrical**

Mobilization  
Shop Drawings  
As-Builts/Close-out/O&M Manuals  
Underground - Matls  
Underground - Labor  
Conduit -Matls  
Conduit - Labor  
Wire - Matls  
Wire - Labor  
Feeder Wire - Matls  
Feeder Wire -Labor  
Switches/Recpt. Matls  
Switches/Recpt. Labor  
Switchgear - Matls  
Switchgear - Labor  
Temporary - Matls  
Temporary - Labor  
Gas Generator - Matls  
Gas Generator - Labor  
Fixtures - Matls  
Fixtures - Labor  
Low Voltage - Engineering/Submittals  
Low Voltage Lighting- Devices - Matls  
Low Voltage Lighting- Devices - Labor  
Low Voltage Lighting - Wiring - Matls  
Low Voltage Lighting - Wiring - Labor  
Low Voltage Lighting - Programming/Start-up  
Low Voltage Lighting- Training  
Low Voltage Lighting - Close-out Documents  
Voice System - Wiring - Matls  
Voice System - Wiring - Labor  
Video System - Trim-out - Matls  
Video System - Trim-out - Labor  
Video System - Testing  
Master Clock - Matls  
Master Clock - Labor  
Close-out Documents  
Punch List  
Coordination Drawings



**Div. 27 - Communications**

Data System - Matls  
Data System - Labor  
Data System - Testing  
Communications/PA - Control Panels - Matls  
Communications/PA - Control Panels - Labor

**Div. 28 - Electronic Safety and Security**

Fire Alarm - Control Panel - Labor  
Fire Alarm - Wiring - Matls  
Fire Alarm - Wiring - Labor  
Fire Alarm - Devices - Matls  
Fire Alarm - Devices - Labor  
Fire Alarm - Testing  
Fire Alarm - Training  
Fire Alarm - Close-out Documents  
Security Systems - Submittals  
Security Systems - Devices - Matls  
Security Systems - Devices - Labor  
Security Systems - Wiring - Matls  
Security Systems - Wiring - Labor  
Security Systems - Cameras Matls  
Security Systems - Cameras Labor  
Security Systems - DVR Equipment - Matls  
Security Systems - DVR Equipment - Labor  
Security Systems - Programming/Start-up  
Security Systems - Training  
Security Systems - Close-out Docs.  
Video System - Close-out Docs

**Div. 31 - Earthwork**

Detention pond Final County inspection permit document  
Demolition (as applicable)  
Site Clearing & Grubbing  
Earthwork - Matls  
Earthwork - Labor  
Finish Grading Matls  
Finish Grading Labor  
Stabilization Matls  
Stabilization Labor  
Site Drainage - Matls  
Site Drainage - Labor

**Div. 32 - Exterior Improvements**

Chain Link Fence - Matls  
Chain Link Fence - Labor  
Paving - Matls  
Paving - Labor

	Sidewalks - Matls Sidewalks - Labor Erosion Control - Matls Erosion Control - Labor Building Pad - Matls Building Pad - Labor Paving Subgrade  Signage/Striping  Bike Racks  Landscaping - Matls Landscaping - Labor Sod - Matls Sod - Labor Hydromulch - Matls Hydromulch - Labor Irrigation - Matls Irrigation - Labor Irrigation system testing/demonstration  <b>Div. 33 - Utilities</b> Site Storm - Matls Site Storm - Labor Site Sanitary - Matls Site Sanitary - Labor U/G Fire Line - Matls U/G Fire Line - Labor Site Lighting - Matls Site Lighting - Labor Close-out Documents Punch List  <b>Alternates</b> 1 2 3 4 5  Allowances: A. Owner's Betterment Allowance					
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**General Note:** Close-out lists shall include As-builts, O&M's, Demonstration/Training, and any attic owner's stock.

**END OF SECTION**



## SECTION 01 31 13

### PROJECT COORDINATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 REQUIREMENTS

- A. General: notify the Architect whenever there is need of clarification or interpretation of the Contract Documents prior to commencement of work.
- B. Commencement of work without Architect's prior notification means Contractor's acceptance of responsibility.
- C. Commencement of work without Architect's prior notification implies Contractor's understanding of conditions, assemblies, methods, or procedures.
- D. The project superintendent shall notify the Owner on an ongoing basis of ongoing work.

##### 1.2 PRE-INSTALLATION CONFERENCE

- A. General: Notify the Architect 48 hours in advance of certain stages of construction, and, as required by the Architect, organize a pre-installation meeting with each trade individually prior to commencement of their portion of the Work. At a minimum, representatives of the Architect, the General Contractor's project superintendent, and the Sub-contractor's Foreman and Project Manager shall be present at each meeting. The Engineer shall be notified as applicable.
- B. As indicated in each specific section of this Project Manual, or as required by the Architect, these stages generally include, but are not necessarily limited to the following:
  - 1. Division 2 - (Selective) Demolition.
  - 2. 05 50 00 - Miscellaneous metals, ladders, brackets, pipe rails, etc.
  - 3. Division 6 - Finish Carpentry and Millwork
  - 4. Division 7 - installation of waterproofing, vapor barriers, flashing and sheet metal.
  - 5. Division 7 - Installation of roofing system(s) and associated work.
  - 6. 07 21 00 - Concealment of insulation.
  - 7. Division 8 - Installation of doors, frames, windows, and storefronts.
  - 8. 08 71 00 - Installation of finish hardware
  - 9. Division 9 - Installation of plaster and gypsum board products.
  - 10. Division 9 - Installation of tile, flooring, and pavers.
  - 11. 09 51 00 - Installation of acoustical ceiling (grid and panels).
  - 12. 09 65 19 - Installation of resilient flooring and base.
  - 13. 09 91 00 - Painting and staining (each coat).
  - 14. Divisions 22, 23 and 26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
  - 15. Division 23 - Installation of heating, ventilating and air conditioning.
  - 16. Division 26 - Installation of all electrical fixtures.
  - 17. Divisions 22, 23 and 26 - Any and all testing specified for equipment, mechanical, electrical and plumbing systems.
  - 18. 31 00 00 - Clearing and stripping of top soil within limits of grading.
  - 19. 31 00 00 - (Excavation and) Placing (of each lift of) select fill material, and site grading.
  - 20. 31 00 00, 31 23 23.13, and Divisions 22, 23 and 26 - Compaction, inspection, testing, and covering of underground utilities.
  - 21. Division 32 - Installation of site amenities, fencing, surfaces, landscaping, etc.

- C. In addition to notifying the Architect, notify the Structural Engineer (48 hours) prior to the following stages:
  - 1. Drilling, reinforcing, and placing of first piers and footings.
  - 2. Placing first reinforcing and grade beams.
  - 3. Erecting structural steel elements.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 - EXECUTION**

### **3.1 PRE-CONSTRUCTION CONFERENCE**

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.

### **3.2 CONFERENCES AND MEETINGS**

- A. Refer to Section 01 31 19, Project Meetings for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

**END OF SECTION**

## SECTION 01 31 19

### PROJECT MEETINGS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 REQUIREMENTS INCLUDE

- A. The Architect will:
  - 1. Schedule each meeting (pre-construction conference, periodic project meetings, pre-installation meetings, and specially called meetings throughout the progress of the work).
  - 2. Prepare agenda for meetings.
  - 3. Preside at meetings, including all significant proceedings and decisions.
  - 4. record, reproduce, and distribute copies of meeting minutes within seven (7) days, excluding weekends and holidays, after each meeting to:
    - a. All participants in the meeting.
    - b. All parties affected by decisions made at the meeting.
- B. The Contractor shall:
  - 1. Make physical arrangement for meetings.
  - 2. Participate in all meetings and conferences.
  - 3. Schedule attendance of Job Superintendent, Project Manager, and other parties affecting or affected by decisions made at meetings and conferences as their interests require.
  - 4. Provide updated schedules.
  - 5. Provide status reports/logs of RFIs, CPRs, MCs, and shop drawings/submittals.

#### PART 2 - PRODUCTS

Not Used

#### PART 3 - EXECUTION

##### 3.1 PRE-CONSTRUCTION CONFERENCE

- A. Architect will:
  - 1. administer pre-construction conference for the establishment of communication methods, procedures and Owner requirements.
  - 2. administer site mobilization conference for clarification of Owner and Contractor.
- B. Location: At Project site or as designated by the Architect.
- C. Attendance:
  - 1. Contractor or Contractor's Representative
  - 2. Job Superintendent
  - 3. Project Manager
  - 4. Owner or Owner's Representative
  - 5. Major subcontractors
  - 6. Major suppliers
  - 7. Architect's Representative
  - 8. Consultants as needed
  - 9. Third-party Consultants
  - 10. Others as appropriate

- D. Meeting Agenda, may include, but is not limited to:
  - 1. Discussion on major subcontracts and suppliers and projected construction schedules.
  - 2. Critical work sequencing.
  - 3. Major equipment deliveries and priorities. Discussion of long lead time items.
  - 4. Project coordination and designation of responsible personnel.
  - 5. Procedures and processing of field decisions, proposal requests, requests for information (RFIs), submittals, minor changes, change orders and applications for payment.
  - 6. Method of distribution of contract documents.
  - 7. Procedures for maintaining record documents.
  - 8. Use of premises, office work and storage areas, on-site parking, and owner's requirements.
  - 9. Construction facilities and temporary utilities.
  - 10. Housekeeping procedures.
  - 11. Special owner requirements (specifications sections 01 35 23, 01 35 23.1 and 01 35 23.2)
  - 12. Lien release requirements

### 3.2 PRE-DEMOLITION CONFERENCE

- A. Owner will:
  - 1. Administer pre-demolition conference for the establishment of communication methods related to demolition procedures and Owner coordination and scheduling requirements for demolition scope.
- B. Location: At Project site or as designated by the Architect.
- C. Attendance:
  - 1. Contractor or Contractor's Representative
  - 2. Job Superintendent
  - 3. Project Manager
  - 4. Owner or Owner's Representative
  - 5. Major Subcontractors
  - 6. Demolition Subcontractors
  - 7. Architect's Representative
  - 8. Consultants as needed
  - 9. Third-Party Consultants
  - 10. Others as appropriate
- D. Meeting Agenda, may include, but is not limited to:
  - 1. Discussion on projected demolition schedules.
  - 2. Procedures for coordination of demolition sequencing and scheduling.
  - 3. Procedures for coordination associated with existing building components need to be returned to Owner.
  - 4. Project demolition coordination and designation of responsible personnel.
  - 5. Procedures for maintaining record documents.
  - 6. Special owner requirements (specifications section 01 36 13).

### 3.3 PROGRESS MEETINGS

- A. Architect will:
  - 1. Schedule project meetings throughout progress of the work at intervals to be determined.
  - 2. Set agenda and administer said meetings.
  - 3. Preside over meetings.
  - 4. Record meeting minutes, including all significant proceedings and decisions.
  - 5. Reproduce and distribute copies of meeting minutes within seven (7) days, excluding weekends and holidays, after each meeting to:
    - a. All participants in the meeting.
    - b. All parties affected by decisions made at the meeting.

- B. Contractor shall:
  - 1. Make physical arrangements for meetings.
  
- C. Attendance:
  - 1. Contractor or Contractor's Representative
  - 2. Job Superintendent
  - 3. Project Manager
  - 4. Owner or Owner's Representative
  - 5. Major subcontractors
  - 6. Architect's Representative
  - 7. Consultants as needed
  - 8. Others as appropriate
  
- D. Meeting Agenda, may include, but is not limited to:
  - 1. Review and approval of minutes of previous meeting.
  - 2. Review of work progress since previous meeting.
  - 3. Field observations, problems, and conflicts.
  - 4. Review of off-site fabrication and delivery schedules.
  - 5. Corrective measures and procedures to regain projected schedule.
  - 6. Review three week "look-ahead" construction schedule.
  - 7. Maintenance of quality standards.
  - 8. Response to request for information (RFIs) and status of outstanding RFIs.
  - 9. Status of submittals.
  - 10. Status of CPRs.
  - 11. Status of MCS.
  - 12. Other items and critical issues affecting work.

### 3.4 PRE-INSTALLATION CONFERENCES

- A. Architect will convene a pre-installation conference, when required in individual specification Section, prior to the Contractor commencing Work of the Section. The Contractor will produce agenda, Architect will distribute copies of the pre-installation conference minutes within seven (7) days, excluding weekends and holidays, after each conference to all participants in the meeting, the Owner and all parties affected by decisions made at the meeting.
  
- B. Attendance:
  - 1. Contractor's Superintendent(s)
  - 2. Subcontractor's Foreman
  - 3. Contractor's Project Manager(s)
  - 4. Architect's Representative
  - 5. Consultants as needed
  - 6. Owner or Owner's Representative
  - 7. Manufacturer's Representative
  - 8. Others affecting or affected by Work.
  - 9. Third party inspectors
  
- C. Meeting Agenda, may include, but is not limited to:
  - 1. Review of conditions of installation.
  - 2. Preparation and installation procedures.
  - 3. Coordinate with related work
  - 4. Review of the contract document requirements.
  - 5. Questions related to work required.
  - 6. Mockup samples or panels



### **3.5 MONTHLY PAY APPLICATION REVIEW MEETINGS**

- A. The Owner, Architect, and Contractor shall schedule and conduct monthly Pay Application review meetings during the entire duration of construction prior to the submission of the notarized completed Contractor Application for payment to the Architect for certification. The Contractor shall produce a draft of the proposed Application for Payment for review by the Owner and Architect. The Contractor shall include and furnish the following documents for review:
  - a. Draft of the Contractor's Application for Payment (AIA Document G702)
  - b. Invoices for any stored materials included in the Application. Invoices shall include full descriptions and costs as required to facilitate on-site review
  - c. Release of Liens from Subcontractors and Sub-subcontractors for all work billed in previous certified Applications for Payment.
  - d. Owner reserves the right to require Release of Liens for any previously submitted notice of claim submitted by any Subcontractor, Sub-subcontractor, or suppliers.
  - e. Evidence of payment for any and all backcharges, overtime, etc. previously issued by Owner that would be past due by the time payment is made by Owner.
  - f. Pay Application review checklists fully completed.
  - g. Updated project schedule
  - h. Owner may withhold payment on line items for which a lien or claim (or similar notice of intent) has been filed, until satisfactory release has been received and accepted by Owner.
- B. Attendance:
  - a. Owner's representative
  - b. Architect
  - c. Contractor
  - d. Subcontractors as appropriate
- C. Meeting agenda may include, but is not limited to:
  - a. Review percentages of work completed and being billed to date.
  - b. Review of any stored materials being billed to date and all associated surety recommendations
  - c. Review of lien releases, notices of claims, etc.
  - d. Confirmation of approved CPRs
- D. The meeting date shall be determined by the Architect, Contractor, and Owner, and shall occur on that same date each month.

### **3.6 SAMPLE MEETING AGENDA**

Refer to the following pages for a sample Pre-Construction Meeting agenda.

### **3.7 SUBMISSION OF FINALIZED APPLICATION FOR PAYMENT**

Refer to AIA Document A201<sup>TM</sup>-2017, as amended, Article 9.

***SAMPLE PRECONSTRUCTION MEETING AGENDA:***

**PROJECT NAME  
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT**

**CYPRESS-FAIRBANKS I.S.D. BID NUMBER:  
PRE-CONSTRUCTION CONFERENCE**

**AGENDA**

Date:  
Time:  
Location: Cypress-Fairbanks Independent School District  
Facilities and Construction Office  
11430 Perry Road  
Houston, Texas 77064

**I. INTRODUCTION OF PERSONNEL**

A.	OWNER:	Cypress-Fairbanks I.S.D.	(281) 897-4108
1.	Name	Title	Phone Number
B.	ARCHITECT:		
1.	Name	Title	Phone Number
C.	CONTRACTOR:		
1.	Name	Title	Phone Number
D.	THIRD PARTY INSPECTORS		
1.	Name	Title	Phone Number

**II. REVIEW CONSTRUCTION GUIDELINE REQUIREMENTS**

**III. SUB/TRADE START-UP MEETINGS**

**IV. REVIEW CONSTRUCTION PROGRESS MEETING PROCEDURES**

**V. SPECIAL OWNER REQUIREMENTS**

**VI. DOCUMENTS MODIFYING AND/OR CLARIFYING THE CONTRACT**

- A. Minor Change Form
- B. Change Proposal Request Form
- C. Clarification
- D. Construction Change Directive
- E. Warranty Work Request
- F. Change Order Form
- G. Claims for additional time since last meeting (weather delays, etc.)

**VII. SCHEDULE, SITE OPERATIONS SET-UP AND MOBILIZATION**

**VIII. DISCUSSION**

**IX. LIEN RELEASE LOG AND BACKCHARGE LOG REVIEW**

**X. CLOSEOUT REQUIREMENTS**

**MEETING ADJOURNMENT**

**PROJECT:**

**CONSTRUCTION GUIDELINE REQUIREMENTS**

The Construction Guideline Requirements supplement the project documents and procedures established for the cooperation and coordination between the Contractor, Architect, and related activities scheduled throughout the construction project.

**I. RECORD DOCUMENTS AT JOB SITE**

- A. The Contractor shall maintain throughout the construction of the project a record set of documents at all times secured to the document table. These plans shall be updated to reflect any changes to the original drawings. Field clarifications, minor changes, addenda, and change orders are to be posted and/or noted on these drawings to document the actual project record conditions.
- B. The Contractor, at all times, shall maintain a record set of project specifications reflecting the information noted in Item 01.

**II. TESTING PROCEDURES**

- A. The Testing Laboratory shall be scheduled through the General Contractor to monitor the soils, concrete, rebar, structural steel, and other testing services required throughout the project. The General Contractor will be required to provide a 48-hour advanced notice to the testing laboratory for scheduled inspections.
- B. Concrete pours shall be scheduled by the General Contractor 48 hours in advance of the scheduled pour. The General Contractor will be responsible for scheduling both Architect's representative and the testing laboratory for observation and testing of the scheduled concrete pour. Unless prior approval has been arranged, all concrete pours are to be made in the presence of the testing laboratory and/or Architect's representative, following their review of all reinforcing steel and miscellaneous items.

**III. FIELD INSPECTIONS**

- A. Mechanical, Electrical, and Plumbing inspections shall be in compliance with the contract documents. Excavation, materials, installation, backfill, and cover-up shall be reviewed by a representative from Architect, the Owner, and/or an outside consultant in the required sequences for each scheduled activity. The General Contractor will be required to provide a 24-hour advance notice for each scheduled activity to be reviewed.

**IV. SUBMITTALS**

- A. Shop Drawings and/or submittals shall be submitted to the Architect in the required quantities (re: specs), with the Contractor's stamp affixed to all items and signed by the Contractor signifying he has reviewed each submittal and it meets exceeds all Contract requirements. Shop drawings or submittals not containing this information will be returned not approved. Commencement of work without reviewed and approved shop drawings will not be permitted. The Contractor will provide a list of shop drawings and/or submittals within 1 month of contract award noting the critical and/or priority items requiring immediate review and approval. Dates for submission of all items will also be provided. A complete set of shop drawings shall be maintained at the field office and their status reviewed at each construction progress meeting.

**V. CHANGES IN THE WORK**

- A. Change Requests involving additions, deletions, and/or revisions to the contract documents must be submitted by the Contractor to Architect's office in writing accompanied by an itemized material, labor, and equipment breakdown for review and approval prior to any changes occurring. Response to all minor changes and proposal requests must be submitted to Architect within 20 days for review and response.

**VI. LIST OF SUBCONTRACTORS**

- A. A list of each Subcontractor scheduled to perform work on the project should be submitted to Architect at the start of the project with Schedule of Values and before review of the first Application for Payment. (Use AIA Document G805)
- B. Prior to the commencement of work by each Subcontractor, a meeting will be scheduled to review the requirements, materials, and/or equipment specified in the contract documents.

**VII. SCHEDULE OF VALUES**

- A. The Schedule of Values shall be approved by Owner and Architect prior to submitting the first pay application. This Schedule shall include the monetary values for each item of construction, breaking out the labor and material for each activity. (Use AIA Documents G702 and G703)

**VIII. PROGRESS SCHEDULE**

- A. Progress Schedules shall be approved by Owner and Architect prior to submitting the first pay application. This schedule shall be a graphical projection of construction activities subdivided into various components and outlining the anticipated starting and completion dates. Indicate the "critical path" items and update the schedule monthly and recovery if required.

**IX. CONTRACTOR'S APPLICATION FOR PAYMENT**

- A. Pay applications will be reviewed monthly at the project site. The pay application will be in a preliminary draft for the review by Architect's and the Owner's representative. The reviewed, accepted, and/or modified pay application will be submitted to Architect's office for processing. Affected subcontractors and/or material suppliers are requested to be present at each pay application review. Progress schedules are to be revised and updated monthly and submitted with each preceding application for payment.
- B. Stored materials are required to be in accordance with Section 9.3.2.

**X. PROGRESS MEETINGS**

- A. Progress meetings will be held to discuss job progress, coordination, schedule, and anticipated conflicts. Those in attendance will be the Owner, Architect, General Contractor, affected subcontractors, and/or particular consultants. Frequency of the progress meetings will be determined by job conditions. The Architect will keep accurate minutes of the meetings and distribute copies to all in attendance.

**XI. LINES OF COMMUNICATION**

- A. The Architect is the Owner's representative and all communications between the Owner and General Contractor shall be channeled through the Architect. Subcontractors shall correspond with the Owner and/or the Architect through, or in the presence of, the General Contractor.
- B. The Superintendent shall be fully knowledgeable of the contract documents. Review and approval by the Superintendent of all items prior to observations by the Architect and/or Owner's representative is essential in avoiding project delays and re-inspection of nonconforming work.

**XII. ADDITIONAL SERVICES**

- A. Additional architectural or engineering services and testing or retesting to analyze and inspect nonconforming work shall be at the Contractor's expense.

**XIII. APPROPRIATE CONDUCT**

- A. Appropriate conduct and language must be exercised by all construction workers. Appropriate clothing must be worn at the job sites by all workers. Misconduct involving a worker will constitute immediate dismissal and removal of said worker from the project site.
- B. The Contractor shall comply with all Special Owner Requirements per Specification Section 01 35 23 herewithin.

**XIV. SUBSTITUTIONS**

- A. Substitutions not approved prior to proposal will not be considered.

**XV. SUBSTANTIAL COMPLETION AND CLOSE OUT**

- A. The General Contractor shall submit in written form a list of items requiring completion (per contract requirement) and/or correction along with a written request for substantial completion.
- B. The General Contractor shall submit all of the required documents, information, and materials to the Architect to expedite project close-out as outlined in the Project Close-Out Specifications.

**PROJECT:**

**CONSTRUCTION TRADE START-UP MEETING GUIDELINES**

The Architect shall direct the General Contractor to arrange a time and location 48 hours prior to a new trade commencing work for the purpose of reviewing and discussing the project documents and specifications governing the particular Subcontractor's work.

The reviews should include, but not be limited to, the following:

1. Determine if all appropriate shop drawings, samples, and/or literature has been submitted, reviewed, and approved.
2. Determine if the Subcontractor has all the current documents to begin and complete his work in compliance with the contract.
3. Inform the Subcontractor/Foreman that if inspections will be needed, the Contractor must provide the Architect with a 48-hour advance notice.
4. Review with the Contractor and Subcontractor any storage or temporary staging areas required and whether there will be conflicts with other trades.
5. Determine if Subcontractor/Foreman has knowledge of what area his work will commence and the sequence to be followed.
6. Examine thoroughly each part and section of the specifications, noting materials, workmanship, manufacturer's recommendations, installation, etc.
7. Alert the Contractor and Subcontractor to special conditions outlined in the project documents and/or project specifications required by the Architect, Owner, or related Consultants.
8. Emphasize that clean-up is a very important item in the overall construction of the project and that an unsightly project will not be tolerated.
9. Inquire if there are any questions relating to the specific areas covered or questions about areas not specifically covered.
10. Review coordination drawings required by Contract.

**PROJECT:**

**JOB PROGRESS MEETING GUIDELINES**

The Architect shall consult with the Owner's representative to determine at what intervals progress meetings will occur. The Architect shall inform the General Contractor of the time, date, and locations of the Construction Progress Meetings and the regularity of the proposed scheduled meetings.

**ARCHITECT**

1. The Architect shall prepare a Record of Attendance sign-in sheet for those attending the progress meeting.
2. The Architect shall preside over the order of the meeting. The Architect shall then recognize the General Contractor's representative, who will address the items outlined under the Contractor.
3. Following the completion of the Contractor's agenda, comments will be received and/or offered by the Owner, Architect, Contractor, and any member in attendance at the progress meetings.
4. The Architect shall submit to the Owner and Contractor notes describing the accounts of the progress meeting, including the time, date, and location of the next scheduled meeting.
5. The Architect, upon reviewing the previous meeting minutes with the Owner and General Contractor, shall amend, add to, or accept as submitted. The meeting notes will then be mailed to the Owner and Contractor for their record copy of the accepted meeting notes.

**CONTRACTOR**

1. The Contractor, at the beginning of each progress meeting, shall submit an agenda outlining those scheduled to attend, an updated progress schedule, and any other matters of interest requiring discussions and/or immediate response affecting the overall construction progress.
2. The progress meetings shall be attended by the Project Manager, Field Superintendent, representatives from trades in progress or trades to begin work prior to the next scheduled meeting. Materials suppliers and/or other representatives impacting the current or near-current construction schedule shall also be in attendance.
3. The Contractor shall review and update the construction schedule by noting progress, work in progress, and anticipated work to begin. Areas of delays in deliveries, materials, equipment, manpower, utilities, pending architectural responses, and/or pending Owner responses that may affect the construction progress shall be addressed in conjunction with the construction progress schedule.

**END OF SECTION**

## SECTION 01 31 29

### NOTIFICATION OF ARCHITECT REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 REQUIREMENTS

- A. In general, the Contractor shall notify the Architect whenever there is need of clarification of interpretation of the Contract Documents.
- B. The Contractor shall notify the Architect 48 hours in advance of certain stages of construction. The project superintendent shall notify the Owner's Representative on an ongoing basis of ongoing work. These stages shall include, but are not necessarily be limited to the following:
1. Division 2, Division 31 - Clearing of site.
  2. Div 31-33 - Stripping of top soil within limits of grading.
  3. Div 31-33 - (Excavation and) Placing (of each lift of) select fill material.
  4. Div 31-33 - Compaction, inspection, testing, and covering of underground utilities.
  5. 31 63 29 - Drilled and reamed foundation piers.
  6. 31 23 00 - Excavation of grade beams.
  7. 03 30 00, 04 22 13 - Placing of concrete.
  8. 07 81 00 - Concealment of insulation.
  9. 07 84 00 - Installation of firestopping and firesafing.
  10. 07 52 19 - Modified Bitumen Membrane Roofing System
  11. 07 92 00 - Installation of building and glazing sealants.
  12. 08 80 00 - Installation of glazing and glazed systems.
  13. 09 21 16 - Installation of gypsum wallboard.
  14. 09 30 13 - Installation of ceramic tile.
  15. 09 51 00 - Installation of acoustical ceiling (grid and panels).
  16. 09 65 19 - Installation of resilient flooring and base.
  17. 09 68 00 - Installation of carpeting.
  18. Division 09 - Painting and staining (each coat), Elastomeric coatings, etc.
  19. Division 02 - Abatement work
  20. Division 23 - Installation of heating, ventilating and air conditioning system.
  21. Division 23 - HVAC system startup
  22. Division 22 - Installation of plumbing fixtures.
  23. Divisions 21-26 - Any and all testing and training specified for equipment, mechanical, electrical and plumbing systems.
  24. Divisions 21-26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
  25. Division 26 - Initiation of permanent power
  26. Division 26 - Installation of all electrical fixtures.
  27. Division 27-28 - Installation of all data, low voltage, security, special systems, fire alarm, and misc. technology systems.
  28. Notify the Architect and the Owner: All pre-construction or trade startup meetings.
  29. Owner shall be given notification/opportunity to conduct inspections prior to wall or ceiling cover up.
- C. In addition to notifying the Architect, the Contractor shall also notify the Structural Engineer (48 hours) prior to the following stages:
1. Drilling, reinforcing, and placing of first piers and footings.
  2. Placing first reinforcing and grade beams.
  3. Erecting structural steel elements.



- D. Above ceiling inspections shall be completed prior to cover up. All systems are to be reviewed at the same inspection. All systems shall be 100 percent complete prior to inspection.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 - EXECUTION**

### **3.1 PRE-CONSTRUCTION CONFERENCE**

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction and/or trade startups meeting with Contractor, Architect, Owner, and third-party firms. This meeting must occur prior to commencement of any construction.

### **3.2 CONFERENCES AND MEETINGS**

- A. Refer to Section 01 31 19, Project Meetings for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

**END OF SECTION**

## SECTION 01 32 16

### CONSTRUCTION PROGRESS SCHEDULE

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.

##### 1.2 SUBMITTALS

- A. Schedules:
  - 1. Preliminary Analysis: Within fourteen days after receipt of Notice to Proceed, submit a preliminary construction schedule for review.
  - 2. Construction Schedule: Within four weeks after receipt of Notice to Proceed, submit one reproducible and four prints of the construction schedule.

##### 1.3 RELIANCE UPON SCHEDULE

- A. The construction schedule as approved by the Architect will be an integral part of the Contract, and will establish conditions for various activities and phases of construction.

#### PART 2 - PRODUCTS

##### 2.1 CONSTRUCTION SCHEDULE

- A. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished.
- B. General Requirement:
  - 1. Contractor shall provide a completed Project Schedule as outlined below 14 days after Contract Award for review and comment by Owner and Architect
  - 2. Activities shown on the schedule shall include, but not necessarily be limited to:
    - a. Project mobilization.
    - b. Submittals and approvals of shop drawings and samples.
    - c. Phasing of construction.
    - d. Procurement of equipment and critical materials.
    - e. Fabrication and installation of special material and equipment.
    - f. Final clean-up.
    - g. Final inspection and testing.
    - h. Air and water balancing.
    - i. Demonstrations for Owner and Owner's staff.
    - j. Punch lists.
    - k. Project closeout.
    - l. Commissioning Schedule
  - 3. The project Schedule shall be divided by trade/spec section and by area of the building with each section to include such items as material delivery dates, below-grade finish/install, above-grade finish/install, trimout, etc. Detail to include specific components of the trade being scheduled (for example: painting would show clean/prep. Block fill, first coat, finish coat, etc.).
  - 4. Project Schedule shall include the amount of anticipated weather days allocated for the Project at the appropriate months, and should also include such milestones as permanent power, chiller startup, etc. where applicable.

5. Contractor shall complete the subcontract trades buyout process 30 days after the Contract award.
6. Contractor shall ensure that all required submittals are submitted for review no later than 60 days after Contract award.
7. Project schedule shall be initially scheduled to allow Initial Completion 60 days prior to Substantial Completion. The 60-day period between Initial Completion and Substantial Completion shall be allocated for such items as the following:
  - a) *Initial Final Clean*
  - b) *Trial owner's systems testing*
  - c) *Owner's tests and inspections*
  - d) *Owner's systems demonstrations*
  - e) *Establishment of required stand of grass*
  - f) *Correction of Contractor's punch list*
  - g) *Owner/Architect punch list*
  - h) *Correction of Owner/Architect punch list*
  - i) *Final clean to deliver building after all tests and inspections*
  - j) *Substantial Completion*
  - k) *Test and Balancing*
  - l) *Commissioning*
8. Schedule shall also include a review of O&M manuals 30 days prior to Substantial Completion and shall include submission of a closeout document binder mock-up.

## 2.2 CONSTRUCTION SCHEDULE LIMITATIONS

- A. Work performed under this Contract shall be performed in accordance with the following paragraphs so that the Owner can accept the project as substantially complete as noted below.
- B. The project schedule begins upon Notice to Proceed and continue uninterrupted with the following requirements:
  1. The entire project shall be substantially complete by dates noted in the Standard Form of Agreement between Owner and Contractor (AIA Document A101™-2017, as amended) subject to Liquidated Damages as listed in General Conditions of the Contract for Construction as amended (AIA Document A201™-2017, as amended) and Supplemental Conditions (Section CB).
- C. Certificates of Substantial Completion may be issued for any of the above mentioned areas of work which are complete prior to the completion of the entire project, provided that all contract requirements for Substantial Completion are met for that portion of the Work. However, warranties shall commence on date of Substantial Completion of entire project. Maintenance required by equipment manufacturers shall be performed by Contractor through the agreed-upon Substantial Completion date, unless specified otherwise in the Contract Documents.
- D. For work during Summer: Any construction related activities after (Last Day of School) and before the start of the next school year, must occur during CFISD normal working hours of Monday through Thursday (10-hour days) or the contractor must request and pay for overtime request to have the building open per Special Owner Requirements Section 01 35 21.1. This requirement will also apply to any work during the school year outside the normal CFISD working hours. The 4-day/10-hour day schedule will only be applicable during scheduled summer break.

**END OF SECTION**

## **SECTION 01 32 23 - SURVEY AND LAYOUT DATA**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 QUALITY CONTROL**

- A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Owner's Representative if required by the Contract.

#### **1.2 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit name, address, and telephone number of Surveyor to Owner's Representative before starting survey work.
- C. Submit documentation verifying accuracy of survey work on request.
- D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

#### **1.3 PROJECT RECORD DOCUMENTS**

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.
- C. Submit record documents under provisions of Division 1.

#### **1.4 EXAMINATION**

- A. Verify locations of survey control points prior to starting the Work.
- B. Notify Owner's Representative immediately if any discrepancies are discovered.

#### **1.5 SURVEY REFERENCE POINTS**

- A. The Owner will establish survey control datum as indicated on Drawings. Inform Owner's Representative in advance of time additional horizontal and vertical control points will be established so verification deemed necessary by Owner's Representative may be done with minimum inconvenience to the Owner or Contractor.
- B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.
- C. Notify Owner's Representative a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.
- D. Promptly report loss or destruction of reference points to Owner's Representative.
- E. Reimburse the Owner for cost of reestablishment of permanent reference points disturbed by construction operations.

**1.6 SURVEY REQUIREMENTS.**

- A. Utilize recognized engineering survey practices.
- B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.
- C. Establish elevations, lines and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:
  - 1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, and ground floor elevations.
- D. Periodically verify layouts.

**PART 2 PRODUCTS - Not Used**

**PART 3 EXECUTION - Not Used**

**END OF SECTION 01 32 23**

## SECTION 01 33 00

### SUBMITTALS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Refer to Section AB for substitutions.

##### 1.2 PROCEDURES

- A. Transmit each item with approved form identifying project, contractor, subcontractor, major supplier; identify pertinent drawing sheet and detail number and specification section number, as appropriate. Identify deviations from Contract Documents.
- B. Apply Contractor's stamp, signed, to each item submitted, certifying that review and verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- C. Revise and resubmit submittal as required; identify all changes made since previous submittal.
- D. After review, distribute copies to all concerned parties.

##### 1.3 SHOP DRAWINGS AND PRODUCT DATA

- A. Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended, 3.12.13 for the number of copies required. Transmit Consultant and Engineering submittals directly to respective consultants with a transmittal to the Architect.
- B. The Contractor shall provide composite drawings within 4 weeks of Notice To Proceed, showing how all piping, ductwork, lights, conduit, and equipment, etc. will fit into the ceiling space allotted, including clearances required by the manufacturer, by Code, or in keeping with good construction practice. Space for all trade elements must be considered on the same drawing. Drawings shall be 1/4 inch per foot minimum scale and shall include invert elevations and sections required to meet the intended purpose.
- C. Manufacturer's Instructions: When work is specified to comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Architect at least two weeks prior to start of such work.
- D. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures, and miscellaneous items specified. If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, then the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings, and miscellaneous items. When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Architect for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

##### 1.4 SAMPLES

- A. Submit full range of manufacturer's standard colors, textures, and patterns for Architect's selection. Submit samples for selection of finishes in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor. All color samples to be physical samples, not digital unless requested by Architect.

- B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- C. Submittals shall contain:
  - 1. Date of submission and dates of any previous submissions
  - 2. Project title and number
  - 3. Contract identification
  - 4. Names of Contractor, Supplier, Manufacturer
  - 5. Identification of sample, with specification section number
  - 6. Note any deviation from contract documents
- D. Resubmission Requirements for Samples:
  - 1. Make any corrections or changes in the submittals required by the Architect and resubmit until approved.
  - 2. Submit new samples as required for initial submittal.
- E. Submit the number specified in the respective Specification section; minimum of two, one will be retained by Architect. Reviewed samples may be used in the work if so indicated in the specification section.

## **2. MANUFACTURER'S CERTIFICATES AND WARRANTIES**

- A. Submit required certificates and warranties in duplicate.

**END OF SECTION**

## SECTION 01 35 23

### SPECIAL OWNER REQUIREMENTS

This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign this document and an original, notarized copy will be attached to the Construction Contract.

1. **Substantial Completion: Refer to the General Conditions of the Contract for Construction as amended, Paragraph 9.8.**
2. **Documentation of Existing Conditions**
  - a. Conditions of improvements (roads, landscape areas, signage, building exterior and interior, etc.) at the building site where work is scheduled to occur are considered to be in good condition. The Contractor shall document through the use of digital video, any existing defects in areas where work will actually be performed, including but not limited to, staging areas and areas of circulation around the site, prior to the start of any construction. Contractor shall also test and document building and site systems (fire alarm, sound, irrigation, etc.) These systems are considered to be in good operating condition unless documented otherwise. A copy of all digital video (flash drive) must be filed with the Owner prior to the start of any construction. Any and all defects not specifically identified prior to construction shall be repaired/replaced by the contractor to the satisfaction of the Owner, at no additional cost.
3. **Application for Payment:**
  - a. Pay application(s) must be correctly completed and executed by the Contractor. All numerical columns and tabulations should be correctly totaled to the nearest cent. With each pay application, Contractor shall also submit partial lien releases from all sub-contractors and major suppliers on the form included in this Project Manual, for work performed through the previous accounting period, an updated construction schedule and construction progress photographs. All lien notices received by the Owner from the previous pay period must be cleared by submission of an unconditional release of lien prior to submission and approval of current applications for payment. Noncompliance with these requirements will result in the return of the Application for Payment(s) to the Contractor for correction and resubmittal. Final application for payment shall only be submitted to the Owner upon completion of all close out requirements including but not limited to receipt of Record Documents, Operation and Maintenance Manuals, Owner Orientation and Training Meetings, Consent of Surety, Contractor Final Release of Lien, Contractor's Affidavit of Payment of Debts and Claims, and unconditional final lien releases from all subcontractors, sub-subcontractors and major suppliers and any other closeout requirements per the contract documents.
  - b. **If errors are discovered by the Owner in certified applications for payment, the Owner shall reject the application and return it to the contractor for correction. The specified time period for payment of such applications will start over on the date the Owner receives the corrected certified application for payment from the Architect.**
4. **Construction Schedule:**
  - a. Refer to Section 01 32 16. The Contractor shall provide a detailed construction schedule at the start of the project and shall submit an updated schedule at the weekly construction meetings. This schedule will also identify the estimated percentage of work completed to date for each item of work along with percentage of work remaining to be completed. This information will be used in the verification of the Contractor's Application for Payment. Application for Payment will not be reviewed, approved, and processed without submittal of the initial schedule and subsequent updated schedules throughout the duration of the project.



**5. Use of Alcohol and Tobacco Products:**

- a. Smoking and the use of all tobacco and alcohol products are prohibited at all times on Cypress-Fairbanks ISD property, including the field office. The Contractor will be fined \$250.00 for each infraction of this policy. In addition, the Owner reserves the right to have the Contractor's personnel dismissed from the District property. This policy is strictly enforced by all employees of Cypress-Fairbanks ISD.

**6. Reinspection Fees:**

- a. During the course of the project, should additional inspections be required by the Owner or Consultants to review problems directly created by and attributable to the Contractor, then all associated expenses including mileage shall be deducted from funds remaining to be paid to the Contractor. The Owner or Architect will verbally inform the General Contractor of the intent to request additional reinspection fees at the time of the occurrence and will provide written invoicing within thirty (30) working days after the date of the occurrence.

**7. Job Superintendent:**

- a. The Contractor will be required to keep the job superintendent on the job site full-time during the course of the job until completion of all punch list items. In the event the job superintendent is absent from the job site at any time during the project contract time or during punch list completion and a previously agreed upon substitute is not provided, the Owner may fine the Contractor \$250.00 per occurrence.
- b. The Owner is to be notified at the beginning of the workday if the job superintendent is out sick. If the superintendent is out for any other reason, the Owner is to be notified at least twenty-four (24) hours in advance. In both cases, the Owner is to be informed of the name of the acting job superintendent.
- c. Subcontractors, Sub-subcontractors are not allowed to work unsupervised on the jobsite at any time during the performance of the work including overtime and weekends.
- d. Where multiple sites are part of the construction contract, the Contractor shall furnish a full-time superintendent for each project campus work is to be performed unless otherwise specified or agreed to by the Owner.

**8. Site/Building Rules and Regulations**

- a. The Contractor shall adhere to the following building rules and regulations during the performance of the work within this contract. The Owner will back charge the Contractor in the amount of \$250.00 per occurrence for any violations of any of these rules and regulations. In addition, the Owner reserves the right to remove the person committing the violation permanently from the project site.
  1. No foul language or spitting will be allowed on district property and within the interior of the buildings.
  2. The possession of tobacco products, firearms, alcohol, or illegal drugs is strictly prohibited on school property and is a state and federal law and subject to criminal charges for any such violation.
  3. Workers must be fully clothed. Shorts and tank tops are not allowed on school property.
  4. The Contractor's personnel shall demonstrate professional behavior and respect toward all school district personnel and property. Physical, verbal, or visual contact with students is strictly prohibited.
  5. Any worker with a history of felony convictions or warrants is strictly prohibited from working on district property. The District has the right to perform criminal checks on any worker the Contractor and/or its subcontractors proposes to use on the project prior to

- issuance of security identification badges. The Owner reserves the right to check such records anytime during construction if the Owner deems it necessary for the safety and protection of the students and staff.
6. The Contractor's personnel are not allowed to park on any grass area, under shade trees, sidewalks, or non-vehicular paved areas. The Contractor will be held liable for any resultant damages resulting from the violation of this requirement.
  7. Authorization must be obtained in advance with the campus administrator or the Facilities Planning and Construction Department to enter or access any existing facility campus.
  8. The Contractor, subcontractors or sub-subcontractors shall keep the premises and site free from accumulation of waste, materials or rubbish caused by the work under this contract at each site. Boxes must be broken down prior to removal from the building. Upon completion of the contract work, and prior to the final inspection, have the premises in a neat and clean condition.
  9. The Contractor shall take all precautions necessary for the safety of, and provide protection to prevent damage, injury or loss to:
    - a. All employees on the project and all other persons who may be affected thereby.
    - b. All the work with all the materials to be incorporated therein, whether in storage on or off the site.
    - c. All property at the site and adjacent thereto including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and any other school property.
  10. A competent supervisor who understands the full scope of the work shall be on-site at all times while work is being performed and remain on-site until all punch list items have been completed as specified here within this specification section.
  11. The Contractor shall be responsible to Cypress-Fairbanks I.S.D. for acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the work under the contract.
  12. The Contractor shall not perform any work within the confines of a secured building on a renovation/addition project or after Substantial Completion on a new Project without the District having one District custodian present during performance of the work. The contractor must reimburse Cypress-Fairbanks I.S.D. Operations Department for the overtime costs associated with the after-hours work as specified within this specification section. Refer to Special Owner Requirements Overtime Section 01 35 23.1.
  13. All exterior doors must be kept closed at all times.
  14. All workers must wear badges at all times when on CFISD property. Refer to Special Owner Requirements Badging Section 01 35 23.2
  15. All deliveries shall be received and signed for by the Contractor and not by Cypress-Fairbanks ISD personnel. The Contractor shall post signs, in a location agreed upon by the Owner's Representative, stating where deliveries are to be received and who is to sign for them.

Signature form follows on next page.

By signature of this document, I hereby state that I (or designated representative of this Company as indicated below) have reviewed the project sites, reviewed the Contract Documents, and read the Specifications including the General Conditions as Amended, Supplementary Conditions and Special Owner Requirements in their entirety and do fully understand and agree to fully abide by all requirements established herein.

Respectively Submitted,

By: \_\_\_\_\_  
Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
City, State, Zip Code

(Seal - if Proposer is a Corporation)

Date \_\_\_\_\_ State of \_\_\_\_\_ County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_

Notary Public:

My Commission expires:

**NOTE:** Form must be notarized and attached to the Construction Contract.

**END OF SECTION**

**SECTION 01 35 23.1**

**BUILDING OVERTIME REQUESTS  
SPECIAL OWNER REQUIREMENTS**

This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign this document and an original, notarized copy will be attached to the Construction Contract.

**Contractor Overtime and Building Access**

- A. Owner's building personnel will be present at all times during the performance of the Work by the Contractor should Work be necessary during non-normal hours, weekend, School District employee Holidays and after the date of substantial completion. If the Contractor needs access to the sites other than normal campus working hours, notification shall be provided to the Owner's Representative through the Facilities Planning and Construction Office Project Manager. The attached "Contractor Overtime Building Access Request Form" within this section shall be submitted for all overtime requests to obtain Owner approval.
- B. Overtime requests/scheduling: Contractor shall request with the attached form and submit by noon, a minimum of three (3) days in advance of the anticipated Work an overtime request. These requests shall be a minimum of four (4) hour charge. If Contractor does not work the entire time of requested overtime hours, the Contractor will still be responsible for paying the total requested overtime hours billing. With each request, Contractor will be billed 30 minutes to allow Operations to open and secure the building as well as 30 minutes for lunch.
- C. The Contractor shall compensate the Owner at the rate of twenty-two (\$22.00) dollars per hour for non-normal and weekend hours, and thirty-three (\$33.00) dollars per hour for School District employee Holidays.
- D. Overtime cancellations: Contractor shall request and submit by noon, a minimum of two (2) days in advance of the anticipated Work an overtime cancellation request should scheduled work and overtime not occur. If Contractor fails to cancel, they will be charged the four (4) hour minimum charge.
- E. Invoices will be submitted by the Owner to the Contractor on a monthly basis and are payable upon receipt to Cypress-Fairbanks I.S.D. Operations Department. Payment must be received within thirty (30) days of the invoice date. Owner reserves the right to refuse future overtime requests as well as the rejection of any current application for payment until such time outstanding payments are received.
- F. Hours:
  - 1. Normal School hours: 6:30 AM – 11:30 PM Monday – Friday
  - 2. Summer hours: 6:00 AM – 4:30 PM Monday - Thursday
  - 3. Not including District recognized employee Holidays per academic year calendars on District's website: Spring Break Week, Thanksgiving Week and Winter Break  
6:00 AM – 2:30 PM
  - 4. Food Production, school kitchens:

Elementary	7:00 AM – 3:30 PM for most, verify with Owner
Middle	6:30 AM – 3:00 PM for most, verify with Owner
High	6:00 AM – 2:30 PM for most, verify with Owner
- G. Package renovation and construction projects containing multiple district campuses will require overtime requests/cancellations be submitted for each building as needed.
- H. Overtime agreements made that differ from the above noted guidelines will not be accepted or honored.
- I. For site work only, the Contractor is required to complete the overtime form and submit it to the District. There will be no charge for site work only to the Contractor. The District will notify all parties to inform them work is being scheduled to be performed on our site.

Signature page continued below.

By signature of this document, I hereby state that I (or designated representative of this Company as indicated below) have reviewed the project sites, reviewed the Contract Documents and read the Specifications including the General Conditions as Amended, Supplementary Conditions and Special Owner Requirements in their entirety and do fully understand and agree to fully abide by all requirements established herein.

Respectively Submitted,

By: \_\_\_\_\_  
Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
City, State, Zip Code

(Seal - if Proposer is a Corporation)

Date \_\_\_\_\_ State of \_\_\_\_\_ County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_

Notary Public:

My Commission expires:

**NOTE:** Form must be notarized and attached to the Construction Contract.

**CONTRACTOR  
 OVERTIME / BUILDING ACCESS REQUEST FORM  
 CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT**

<u>CONTRACTOR:</u>	<u>CYPRESS-FAIRBANKS ISD USE ONLY:</u>
1. Date of Request: _____	1. Total Overtime Hours Requested: _____
2. Project: _____	2. Total Overtime Amount Due Cy-Fair ISD: _____
3. CFISD Project Number: _____	3. Date Submitted to Operations: _____
4. Campus: _____	4. Date Submitted to Security: _____
5. Requested Date: _____	5. Date Submitted to Facilities Use: _____
6. Requested Hours: _____ (Minimum 4 hours must be requested)	6. Comments:
7. General Contractor/Subcontractors Working and contact mobile phone numbers:  _____ _____	
8. Project Manager and Superintendent's Name and contact mobile phone numbers:  _____ _____	
9. Requested By: _____	

On a monthly basis and prior to contract closeout and final payment by the Owner, the Contractor hereby agrees to reimburse Cypress-Fairbanks ISD the amount of twenty two (\$22.00) dollars per hour for non-normal days & weekend hours and thirty three (\$33.00) dollars per hour for School District employee Holidays for the above requested overtime hours. Reimbursement will be made by separate check made payable to the Cypress-Fairbanks ISD Operations Department within thirty (30) days of invoice date. If Contractor does not work the entire time of requested overtime hours, the Contractor will still be responsible for the total requested overtime hours. With each request, Contractor will be billed 30 minutes to allow Operations to open and secure the building and also includes 30 minutes for lunch.

Acknowledged and Agreed to by: \_\_\_\_\_  
 Contractor's Signature Date

\_\_\_\_\_  
 Printed Name

Approved by: \_\_\_\_\_  
 CFISD Project Manager's Signature Date

\_\_\_\_\_  
 Printed Name

**END OF SECTION**

## Section 01 35 23.2

### Special Owner Requirements - Badging Process

For Contractors, Sub-Contractors, Service Providers, & Vendors

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

Refer to enclosed instructions and Form AP packet for necessary submission information and procedures.

##### 1.1 SECTION INCLUDES

- A. This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign these documents and an original, notarized copy will be attached to the Construction Contract.
- B. Mandatory photo identification badge with the workers name and name of the Construction Company, which shall be worn at all times *[required after Substantial Completion for new buildings; required at all times for renovations]* shall be provided by the Owner and payable by the General Contractor. The General Contractor shall provide a list of all employees, suppliers, etc., that will be on the job site for more than 1 hour per day. The Owner reserves the right to reject issuing a security badge to any contractor employee as deemed appropriate to protect the Owner's interest. The Owner reserves the right to dismiss any worker not wearing proper identification, from the project site. Back charges are applicable for any infraction of this requirement.
- C. Lists must be forwarded to the Facilities Planning & Construction Department 72 hours or earlier in advance of going to the site.
- D. List shall be submitted on forms contained in Form AP packet.
- E. Should a Contractor want to add names to their original list, they must be added on a separate list.
- F. A maximum of 5 groups of **3-4 workers** may report to the Facilities Planning and Construction Department to have photos taken and pick-up the identification badges, based upon the agreed upon schedule. If more than the maximum number of workers show up, they will be asked to wait, or to return at a later time.
- G. Badges will include the General Contractor, Subcontractor or Sub-subcontractor name, expiration date of the project, and photo identification of the authorized person. The expiration date will typically be 6 months after the scheduled contract substantial completion date, but not longer than one year from date of issuance. Upon expiration, the contractor shall repeat the application process. There is no charge for renewal badges provided that the worker returns his previous badge. Otherwise, the \$10.00 charge applies.
- H. Badges must be worn at all times by all General Contractor, Subcontractor or Sub-subcontractor personnel on school district property during the construction of the project.
- I. The Contractor will be invoiced by Facilities Planning, & Construction and will be responsible for payment within 30 days of the invoice date.
- J. Should a person lose a badge and need a replacement, this procedure will be used to obtain the replacement badge. A \$10.00 charge for the replacement badge will be applicable for all lost badges.
- K. The Contractor shall contact Facilities Planning, & Construction with any questions during the process. The Contractor shall not contact Cypress-Fairbanks Police Department directly.

- L. Contractor shall return all project badges to CFISD. This included but is not limited to the Contractor, Sub-contractor, sub-sub-contractor, etc. Should badges not be returnable, Contractor shall submit letter in writing noting badges are lost for CFISD records as well as be assessed a fee of \$10.00 for each badge not returned to CFISD. If Contractor fails to pay such fees, the Owner will deduct such charges from the final payment.

**PART 2 - PRODUCTS**

Not Used

**PART 3 - EXECUTION**

- 3.1 Refer to and follow the attached instructions.

**END OF SECTION**



## SECTION 01 36 13

### RENOVATION PROJECT PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 REQUIREMENTS INCLUDED

- A. This Section contains general provisions and requirements pertaining to all remodeling, removal, and relocation of Work in the existing building and becomes a part of each Section and Division performing remodeling, removal and relocation Work for this Project with the same force and effect as if written in full therein.
- B. Take all necessary precautions to keep students and other trespassers out of the Work areas. Secure Work areas from entry when Work is not in progress.
- C. Perform all alterations, remodeling, demolition, removal and relocation of Work in strict accordance with Owner's instructions and applicable Federal, State and local health and safety standards, codes and ordinances. Where conflicts occur, the more restrictive requirement shall govern.
- D. Refer to section 01 71 50 Preventive Housekeeping and Final Carpet Cleaning.

##### 1.2 RELATED WORK

- A. Section 02 41 01 - Demolition

##### 1.3 EXISTING CONDITIONS

- A. Obvious existing conditions, installations and obstructions affecting the Work shall be taken into consideration as necessary Work to be done, the same as though they were completely shown or described.
- B. Items of existing construction indicated to remain upon completion of the Contract, but which require removal to complete the Work, shall be carefully removed and replaced as required. The replaced Work shall match its condition at the start of the Work unless otherwise required.
- C. Visit the site to determine by inspection all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.
- D. Utilities: Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Architect/Owner in writing two (2) weeks in advance. Provide temporary services during interruptions to existing utilities.

#### PART 2 - PRODUCTS

##### 2.1 SALVAGED MATERIALS

- A. The Owner reserves the right of first refusal on all salvage items. Remove remaining items from the site as Work progresses. Storage or sale of items on site is not permitted. Burning or burying of removed materials on site is not permitted.
- B. Store salvaged items in a dry, secure place on site.

- C. Salvaged items not required for use in repair of existing Work shall remain the property of the Owner.
- D. Do not incorporate salvaged or used material in new construction except where specified in the Contract Documents

## 2.2 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Contract Documents do not define products or standards of workmanship present in existing construction. Determine products by inspection and by use of the existing. Provide same or similar quality products or types of construction as that in existing structure when needed to patch or extend existing Work.
- B. If reasonably matching products are not obtainable, improve appearance by minor relocating of some existing products and grouping new ones in some pattern arranged by the Architect.

## PART 3 - EXECUTION

### 3.1 PROTECTION OF WORK TO REMAIN

- A. Protect existing Work from damage. Use barricades, tarpaulins, temporary walls, plywood, planking, masking, or other suitable means and methods as approved by the Architect.
- B. If Work to remain in place is damaged, restore to original condition at no additional cost to the Owner.
- C. Concealed Conditions: If conditions cause changes in the Work from requirements of the Contract Documents, the Contract Sum will be adjusted in accordance with the General Conditions.

### 3.2 PROCEDURES

- A. Refinishing At Removed Work: Cut below surface of substrate materials and patch over area of removal with finish materials so removal is not apparent.
- B. Remove and replace existing ceilings, and cut, patch, or replace existing walls, partitions and floors as may be necessary for access to valves, piping, conduit and tubing by mechanical and electrical trades as directed and approved by the Architect, and performed by the appropriate subcontractor for the Work involved, or by other properly qualified subcontractors.
- C. Patch and extend existing Work using skilled mechanics who are capable of matching existing quality and workmanship. Quality of patched or extended Work shall be not less than that specified for new Work.
- D. Cutting:
  - 1. Concrete and Masonry: Saw cut where feasible.
  - 2. Plaster: Cut back to sound plaster on straight lines, and back-bevel edges of remaining plaster. Trim and prepare existing lath for tying of new lath.
  - 3. Woodwork: Cut back to a joint or panel line. Undamaged removed materials may be reused.
  - 4. Resilient Tiles: Remove in whole units to natural breaking points or straight joint lines with no damaged or defective existing tiles remaining where joining new construction.
  - 5. Salvaged Materials: Carefully remove to avoid damage, thoroughly clean and reinstall as indicated, or as directed.
  - 6. Doors: Remove in such a manner as to facilitate filling in of openings or installation of new Work, as required by Drawings. **Refer to Finish Hardware Section for specific**

- requirements for salvage of existing finish hardware.** Provide construction cores as required to maintain security and access control.
7. Structural Elements: Remove only as shown on the Structural Drawings. If not specifically shown, but removal is required, perform such removal or alteration only upon written approval of the Architect. Do not damage or alter any structural element of the existing building.
- E. Patching:
1. Match existing Work where possible; if unavailable, use salvage material for patching and provide totally new material in areas where salvage has been removed; consult with the Architect concerning locations for salvaging materials.
  2. Repairs or continuations of existing Work shall be relatively imperceptible in the finished Work when viewed under finished lighting conditions from a distance of six (6) feet.
  3. Patching, Repairing and Finishing of Existing Work: Perform in compliance with the applicable requirements of the Specification Section covering the Work to be performed and the requirement of this Section.
- F. Erect scaffolding as necessary to gain access to the various parts of the Work. Provide structurally sound, rigidly braced and properly constructed scaffolding, shoring, and bracing as necessary to positively protect the affected elements and building, and to support the activities or workmen and loads. Design and construction of scaffolds and supports shall be in accordance with applicable safety regulations. Material used shall be adequate to support anticipated loads with a properly calculated margin of safety.
- G. Noise Producing Equipment: Minimize use of noise producing equipment. Limit excessive noise to periods of vacancy or provide sound control. Arrange schedules in advance with the Architect and Owner.

### **3.3 EXISTING FURNITURE AND EQUIPMENT**

- A. Owner Salvaged Items: Personal items in areas subject to remodeling will be removed by Owner before construction in those areas commences. Contractor shall notify Owner if any personal items remain; Owner shall remove such items.
- B. Furniture Items - Renovation: Contractor shall be responsible for any furniture relocation, storage, and move-back necessary to complete scope of work. Contractor to coordinate activities with Owner. Contractor is solely responsible for protecting furniture and equipment and is therefore solely responsible for any damage to said items and ensuing costs in restoring damaged items to same condition or replacing lost or damaged items beyond repair, unless specified as an allowance (Section 01 21 00).

### **3.4 PAINTING**

- A. Preparation: Prepare patched areas as required for new Work. Wash existing painted surfaces with neutral soap or detergent, thoroughly rinse, and sand when dry.
- B. Painting and Finishing: Conform to the applicable provisions of the Painting Section. Prepare bare areas and patches in existing painted surfaces with specified primer and intermediate coats, sanded smooth and flush with adjoining surfaces.

### **3.5 DISPOSAL OF DEBRIS**

- A. Remove daily material, debris and rubbish resulting from Work of this Section from the building and site as it accumulates. Keep all areas of Work in "broom clean" condition as the Work progresses.

### **3.6 JOB SUPERINTENDENT**

- A. If renovation project includes Work at more than one site, Contractor shall have supervision at all sites as follows:

**Arnold MS** shall have at least one full-time Superintendent.

**Arnold MS** shall have at least one full-time Assistant Superintendent.

### 3.7 FINAL CLEANING

- A. At completion of renovation and remodeling Work in each area, provide final cleaning of all surfaces and return all areas affected by construction to a condition suitable for use by the Owner. Final cleaning shall include dusting of all surfaces; thorough cleaning of all surfaces including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, lint, discolorations, and other foreign materials; vacuuming of carpets; cleaning of all new carpeting by manufacturer-approved contractor; wet-mop cleaning of tile, and waxing of VCT, terrazzo surfaces per CFISD-approved methods. Refer to section 01 71 50 for Preventive Housekeeping and Final Carpet Cleaning.

**END OF SECTION**

## SECTION 01 36 13.1

### CUTTING AND PATCHING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Execute cutting (including excavating and backfilling), fitting or patching of the work, required to:
  - 1. Make several parts fit properly.
  - 2. Uncover work to provide for installation of ill-timed work.
  - 3. Remove and replace defective work.
  - 4. Remove and replace work not conforming to requirements of the contract documents.
  - 5. Remove samples of installed work as specified for testing.
  - 6. Install specified work in existing construction.
- B. In addition to contract requirements, upon written instruction of the Architect:
  - 1. Uncover work to provide for observation of covered work.
  - 2. Remove samples of installed materials for testing.
  - 3. Remove work to provide for alteration of existing work.
- C. Do not endanger any work by cutting or altering the work or any part of it.
- D. Do not cut or alter the work of another Contractor without written consent of the Architect.
- E. Prior to cutting that affects structural safety of the project or the work of another Contractor, secure written approval of the Architect.

##### 1.2 PAYMENT FOR COSTS

- A. Costs caused by ill-timed or defective work or work not conforming to the contract documents, including the cost of additional services of the Architect, Third-Party Consultants, and Owner, will be borne by the Contractor.
- B. Work done on written instructions of the Owner or Architect, other than defective or nonconforming work, will be paid by the Owner.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Materials required for replacement of the work removed must conform to the specifications for the type of work to be done.

#### PART 3 - EXECUTION

##### 3.1 PREPARATION:

- A. Provide shoring, bracing and support as required to maintain the structural integrity of the project.
- B. Provide protection for other portions of the project.
- C. Provide protection from the elements.

**3.2 PERFORMANCE**

- A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.
- B. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.
- C. Execute excavation and backfilling by methods which will prevent damage to other work and will prevent settlement.
- D. Restore work which has been cut or removed; install new products to provide complete work in accordance with requirements of the contract documents.
- E. Refinish entire surfaces as necessary to provide an even finish. On continuous surfaces, refinish to the nearest intersections. For an assembly, refinish the entire item.

**END OF SECTION**

## **SECTION 01 45 00**

### **QUALITY CONTROL**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### **PART 1 - GENERAL**

##### **1.1 SECTION INCLUDES**

- A. Quality Assurance: Requirements for material and product quality and control of installation
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' field services

##### **1.2 RELATED SECTIONS**

- A. Section 01 41 00 - Regulatory Requirements
- B. Section 01 45 23 - Testing and Inspecting Services
- C. Section 01 33 00 - Submittal Procedures
- D. Section 02 32 00 - Geotechnical Report
- E. The work of this Section shall be included as a part of all Sections of work, whether referenced therein or not.

##### **1.3 DESCRIPTION OF REQUIREMENTS**

- A. Unless specifically noted otherwise, perform all work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
  - 1. Perform work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section.
  - 2. Perform work in the highest quality workmanship, unless specified otherwise.
  - 3. Join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work.
  - 4. Install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials.

5. Attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed.
6. Use concealed fasteners, unless shown or directed otherwise.

#### **1.4 QUALITY ASSURANCE AND CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

#### **1.5 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

#### **1.6 REFERENCES AND STANDARDS**

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with contract documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in contract nor those of Architect/Engineer shall be altered from contract documents by mention or inference otherwise in reference documents.
- F. Refer to Section 01 41 00, Codes, Regulations and Standards, for additional information concerning applicable reference and standards requirements.



## 1.7 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be the comparison standard for remaining work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.
- E. Mock-up may be approved in phases as portions are completed.
- F. Project Mock-up Requirements: Provide an actual sample mockup wall with multiple panels with the following properties:
  - 1. Size: Minimum 8 feet wide by 8 feet tall. Size may vary according to specific project requirements. Brace and support as required to withstand structural windloads.
  - 2. Materials: actual exterior finishes including, but not limited to face brick, cast stone, and plaster, actual building materials and assemblies indicating brick patterns on masonry and stud back-up as occurs with dampproofing and flashing as detailed, actual portion of aluminum storefront indicating jam, sill and head attachment and flashing details, and where appropriate, provide mock-up of special finish details, insets and reliefs, reveals, expansion and control joints, brick ledges, brick head and sills, pipe penetrations and waterproofing materials. Provide roof edge flashing and gutter section (as applicable) in pre-finished color as selected by Architect to cap the mock-up panel. Include a sealant joint at least 16 inches long. Brick and Mortar color shall be selected by Architect prior to mock-up assembly.
  - 3. Drawing: Refer to mock-up diagram on Drawings for minimum project requirements. Mock-up drawing is for reference only. Actual mock-up drawing will be submitted by the Architect after submittals have been approved.

## 1.8 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
  - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
  - 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform work to contract requirements.

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- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 45 29, Inspection and Testing Laboratory Services, for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

### **1.9 INSPECTION SERVICES**

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.
- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
  - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- G. Inspecting does not relieve Contractor to perform work to contract requirements.
- H. Refer to Section 01 45 29, Inspection and Testing Laboratory Services, for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

### **1.10 MANUFACTURERS' FIELD SERVICES**

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00, Submittal Procedures, for additional information concerning submittal procedures and requirements for Manufacturers Field Reports.

## **PART 2 - PRODUCTS**

Not Used.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

**3.2 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

**END OF SECTION**

## **SECTION 01 45 23 – STRUCTURAL TESTING AND INSPECTION SERVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 WORK INCLUDED**

- A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, ASTM specifications and the Contract Documents.
- B. The testing laboratory shall provide as a part of the project's close-out documents or as required by any regulatory authority, all appropriate signed and sealed Special Inspection Certificates whose purpose would be to provide consistency and direction for compliance with the referenced Building Code. These Special Inspection Certificates shall confirm that that all work requiring special inspection has been adequately performed, and the special inspections have been made by an individual or firm that is qualified to make special inspections per the referenced Building Code.
- C. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.
- D. Testing, inspection, and certifications specified in other sections of these Specifications shall be paid by the Owner, unless otherwise indicated.
- E. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

#### **1.3 REFERENCED STANDARDS**

- A. The latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise.
- B. ACI 311 – ACI Manual of Concrete Inspection
- C. ACI 301 - Specification for Structural Concrete
- D. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

#### **1.4 QUALITY ASSURANCE**

- A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.
- B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than \$500,000.

- C. Testing Laboratory shall be under the direction of a Registered Engineer who is legally authorized to practice in the jurisdiction where Project is located and having at least five years experience in inspection and testing of construction materials.
- D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.
- E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- F. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

### **1.5 LABORATORY RESPONSIBILITIES**

- A. Attend preconstruction meetings and progress meetings as required to coordinate work with the Contractor and address quality control issues.
- B. Test samples of design mixes submitted by Contractor.
- C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
- D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.
- E. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non conformance of Work or Materials.
- G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.
- H. Testing Laboratory shall write a letter at the completion of the project, signed, and sealed by a registered engineer in the state of the project, summarizing the inspections performed, the dates they were performed, and whether the observed construction complied with the Contract Documents.

### **1.6 LABORATORY REPORTS**

- A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.
- B. Include:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and specifications section
6. Location in the Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

**1.7 LIMITS ON TESTING LABORATORY AUTHORITY**

- A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

**1.8 CONTRACTOR RESPONSIBILITIES**

- A. See technical sections of these specifications for specific requirements.
- B. Deliver to the laboratory, without cost to the Owner, adequate samples of materials proposed for use which are required to be tested.
- C. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Provide facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM specifications C31.
- E. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.
- F. Furnish concrete mix designs, in accordance with ACI 301, section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs are required, the laboratory shall be selected and paid by the Contractor.
- G. Provide current welder certifications for each welder to be employed.
- H. Furnish fabrication and erection inspection of all welds in accordance with AWS D1.1, Chapter 6.
- I. Prequalification of all welding procedures to be used in executing the work.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION**

**3.1 PIER DRILLING**

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.
- C. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not casing is required, bell size (if required), actual penetration into bearing stratum, and elevation of top of bearing stratum.

**3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES**

- A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.
- B. Observe and report on the following:
  - 1. Number and size of bars
  - 2. Bending and lengths of bars
  - 3. Splicing
  - 4. Clearance to forms including chair heights
  - 5. Clearance between bars or spacing
  - 6. Rust, form oil, and other contamination
  - 7. Grade of Steel
  - 8. Securing, tying and chairing of bars
  - 9. Excessive congestion of reinforcing steel
  - 10. Installation of anchor bolts and placement of concrete around anchor bolts
  - 11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
  - 12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

**3.3 REINFORCING STEEL MECHANICAL SPLICES**

- A. Each mechanical splice shall be visually inspected to ensure compliance with the ICBO Reports and the manufacturer's published criteria for acceptable completed splices.
- B. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the ICBO report.

- C. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and whether splice is accepted or rejected. Reasons for rejection shall be shown on each report.

### **3.4 CONCRETE INSPECTION AND TESTING**

- A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.
- B. Mold and cure specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.
- C. Test specimens in accordance with ASTM C39. Two specimens shall be tested 7 days, two specimens shall be tested at 28 days for strength acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28-day break does not meet strength requirements. If the plans require 56-day break (such as for mass concrete), two samples shall be tested at 56 days for acceptance.
- D. Make one strength test (four or five cylinders) for each:
  - 1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
  - 2. OR, for each 5000 sq. ft. of slab area placed in one day.
  - 3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Architect/Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.
- E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.
- F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- G. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- H. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.
- I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Architect, the Contractor, and the Concrete Supplier.
- J. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications and shall be rejected.



- K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.
- L. Laboratory reports shall contain the following information:
1. Class of concrete and specific location.
  2. Specified strength of concrete.
  3. Air temperature.
  4. Batch time.
  5. Specified time that discharge of concrete must be completed, based on air temperature.
  6. Time concrete is placed.
  7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
  8. Amount of water added at the site.
  9. Allowable slump range on the approved mix design.
  10. Slump.
  11. Maximum and minimum allowable concrete temperature on the approved mix design.
  12. Temperature of the concrete mix.
  13. Air content range on the approved mix design.
  14. Air content.
  15. Statement that concrete is in compliance with the project documents and the approved mix designs.
- M. Evaluation and Acceptance:
1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
  2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.
- N. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- O. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).
- P. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

### **3.5 MASONRY**

- A. Inspection

1. Provide a qualified inspector to inspect all structural masonry work.
    - a. Inspect masonry for compliance in accordance with the "Level 1 or 2 Special Inspection" provisions of the building code. Refer to the contract documents regarding which level of special inspections is required.
  2. In combination with inspections required by the building code, inspect the following:
    - a. Preparation of masonry prisms for testing.
    - b. Placement of reinforcing.
    - c. Cavities to be grouted (prior to grouting and prior to closing cleanouts).
    - d. Mortar mixing operations, including proportion of materials and method of measuring materials (materials should be measured with a mixing box and not a shovel).
    - e. Bedding of mortar for each type of unit and placing of units.
    - f. Grouting operations.
    - g. Condition of units before laying for excessive absorption.
  3. Provide report of each inspection.
- B. Field Compressive Tests for Grout:
1. Secure composite samples of grout at the jobsite in accordance with ASTM C 1019.
  2. Mold and cure three specimens from each sample in accordance with ASTM C 1019. Supervise the curing protection provided (by others) for test specimens in the field and the transportation from the field to the laboratory. The test specimens shall be stored in the field 24 to 48 hours and then be carefully transported to the laboratory and cured in accordance with ASTM C 1019.
  3. Test specimens in accordance with ASTM C 1019. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at 7 days for information.
  4. Make one strength test (three specimens) for each 10 cubic yards of grout poured but not less than one strength test for each 5000 square feet of wall area.
- C. Prism Tests:
1. Build prisms at the jobsite using the same materials and methods as being used for the wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as masonry construction. After 48 hours, move prisms to the laboratory and test in accordance with ASTM C1314.
  2. Make prism tests in advance of operations using materials under same conditions, with the same bonding and construction methods as is being used for the structure. When building prisms, moisture content of the units at time of laying, consistency of mortar and width and thickness of mortar joints shall be same as used in the structure.
  3. Build prisms of hollow masonry units the same width as unit by 16" long by 16" high. Apply mortar to face shells only. Do not fill hollow core with grout. Compute value of ultimate net compressive strength, by dividing ultimate load by net face shell area of masonry units.
  4. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to the jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5000 square feet of wall placed.
  5. The prisms shall be tested after 28 days but may be tested at seven days provided the relationship between seven and 28 day strengths has been established for the materials used prior to the start of construction.

6. When the average strength of a set of prisms falls below the specified compressive strength ( $f'm$ ), the masonry corresponding to the test shall be deemed unacceptable. In such a case, notify the Architect and Contractor immediately.

### 3.6 STRUCTURAL STEEL

- A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.
- B. Field Inspection
  1. Proper erection of all pieces.
  2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
  3. Plumbness of structure and proper bracing.
  4. Field Painting.
  5. Visual examination of all field welding.
  6. Ultrasonic testing of all penetration welds.
  7. Installation of field welded shear studs.
  8. Measure and record camber of all beams upon arrival and before erection for compliance with the specified camber. Measure lying flat with web in horizontal position. Members outside specified camber tolerance shall be returned to the shop for remedial work.
- C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify all welder's qualifications.
- D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:
  1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
  2. Ultrasonically test all penetration welds in accordance with AWS D1.1.
  3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.
  4. The welding inspector shall be present during alignment and fit-up of members being welded and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
  5. The inspector shall check that all welds have been marked with the welder's symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
  6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other

than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.

7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
- E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:
1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.
  2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
  3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration and shall confirm that the procedure to be used provides the required tension.
  4. For slip critical connections, inspect the contact surfaces for compliance with specifications prior to bolting.
- F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1 and as follows:
1. A minimum of two shear studs shall be welded at the start of each day's production period in order to determine proper generator, control unit and stud welding setting. These studs shall be capable of being bent at 45 degrees from vertical without weld failure.
  2. When the temperature is below 32 degrees Fahrenheit, one stud in each 100 shall be tested after cooling. Studs shall not be welded below zero degrees Fahrenheit or when the surface is wet due to rain, snow, or ice. If a stud fails, two new studs shall pass the test before resumption of the welding.
  3. Visually inspect studs for compliance with the Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

### **3.7 OPEN WEB JOISTS AND JOIST GIRDERS**

- A. Inspect all joists either in the plant or at the jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices, and straightness of members. Inspection at the plant may be performed by the manufacturer's qualified QC personnel.
- B. Inspect installation of joists at the jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with the Contract Documents and referenced standards.
- C. Check welder qualification certificates for field welding operators.

### **3.8 STEEL FLOOR DECK**

- A. Field Inspection shall consist of the following:

1. Check types, gauges, and finishes for conformance with the Contract Documents and shop drawings.
2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
3. Certification of welders.
4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the structural steel section of this specification section.

### **3.9 STEEL ROOF DECK**

- A. Field inspection shall consist of the following:
1. Checking types, gauges, and finishes for conformance with the Contract Documents and Shop Drawings.
  2. Examination for proper erection of all metal deck, including fastenings at supports and sidelaps, reinforcing of holes, and miscellaneous deck supports.
  3. Certification of welders.
  4. Visual inspection of at least 20 percent of all welds.

### **3.10 SPRAYED FIREPROOFING**

- A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify that installation meets fire rating requirements of approved design.
- C. Inspect and test for thickness as follows:
1. Test 20 percent of structural frame columns and beams in each building level.
  2. Test 10 percent of beams other than structural frame in each building level.
  3. Test one slab per each 5000 square feet of building area.
- D. Inspect and test for density on slabs, beams, and columns. Perform one of each test for each 10,000 square feet of building area.
- E. Inspect and test for bond strength, one test for beams and one test for slabs for each 10,000 square feet or area.
- F. Inspection and test procedures shall be performed in accordance with ASTM E605 and E736.

### **3.11 EXPANSION BOLT INSTALLATION**

- A. Inspect the drilling of each hole and installation of each expansion bolt for compliance with the Contract Documents.
- B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

**3.12 TESTING OF NON-SHRINK GROUT**

- A. Make one strength test for every 15 base plates grouted and for every 15 bags of grout used in joints between members.
- B. Each test shall consist of four cubes, two to be tested at seven days, and two at 28 days, made and tested in accordance with ASTM C109, with the exception that the grout shall be restrained from expansion by a top plate.

**3.13 EXCAVATION**

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.
- C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.
- D. Review required submittals as they pertain to geotechnical requirements.
- E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.
- F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

**3.14 WATER PRESSURE INJECTION OR LIME SLURRY PRESSURE INJECTION**

- A. The representative of the Owner's Geotechnical Engineer shall make continuous observations throughout the injection operations as per the geotechnical report.
- B. The representative of the Owner's Geotechnical Engineer may propose to perform additional tests if required to properly evaluate the injected soil. The representative of the Owner's Geotechnical Engineer shall evaluate the results of the tests to determine the acceptability of the injected areas and to determine if additional injections are required.

**3.15 FILLING AND BACKFILLING**

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
- C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:

1. Test for liquid limit in accordance with ASTM D423.
  2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
  3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.
- D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.
- E. Inspect under slab drainage material and placement for compliance with specified gradation, quality, and compaction.
- F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:
1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
  2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
  3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

### **3.16 TILT-UP PANELS**

- A. Concrete Reinforcing Steel and Embedded Metal Assemblies: Inspect in accordance with the Concrete Reinforcing Steel and Embedded Metal Assemblies section of this Specification.
- B. Concrete Inspection and Testing: Perform in accordance with the Concrete and Inspection and Testing section of this specification.
- C. Inspection of Tilt-up concrete during erection:
1. Inspect members for cracks, spalls, and other deficiencies after erection.
  2. Inspect erection of tilt-up members for placement tolerances, and to ensure that connections, bearing lengths, welding and grouting conform to the Contract Documents.

### **3.17 POST-TENSIONING**

- A. Verify certification of calibration of jacking equipment used in post-tensioning operations.
- B. Observe and report on placement and anchorage of tendons immediately prior to concreting.
- C. Provide a qualified, experienced inspector to observe the stressing and elongation measurement of each tendon. Inspector shall have a minimum of five years' experience inspecting post-tensioning operations.
- D. The Contractor shall log and submit detailed reports of the stressing and elongation of each tendon. The laboratory representative shall observe the recording of information by the Contractor and make such spot checks as necessary to verify the accuracy of the post tensioning reports.

- E. Receive and review final stressing and elongation reports prepared by the contractor. Compare the actual and required elongation of each tendon and the actual and required load on each tendon. Grant permission to cut tails of tendons which are within the specified tolerance, unless otherwise noted on the Drawings, and submit reports of those which are not within the specified tolerance to the Architect for further evaluation.
- F. Observe and report on grouting of tendons noted to be bonded.
- G. Reports shall be submitted to the Architect within 48 hours after stressing.
- H. The post-tensioning subcontractor shall provide a letter at the completion of the project, signed and sealed by a registered engineer in the state of the project, stating that the post-tensioning work was completed in accordance with the contract documents. The post-tensioning subcontractor shall review the stressing records and certify that the required forces shown on the contract documents have been provided.

### **3.18 FOOTING EXCAVATIONS**

- A. A representative of the Owner's Geotechnical Engineer shall inspect each footing excavation to determine that the proper bearing stratum is obtained and that excavations are properly clean and dry before the concrete is placed.

### **3.19 EXISTING FOUNDATION DEMOLITION**

- A. While it is common for the testing and inspections laboratory to be involved and on-site during earthwork prep. and operations; (including but not limited to: observing and testing earthwork properties, select fill properties, thicknesses, compaction, moisture content, etc.) We also require the testing and inspections laboratory to be on-site for the infill of any and all demolished foundation items, both partially and fully demolished. We have observed instances where the demo contractor did not properly/adequately infill the sub-grade voids and/or compact the infill from existing demolished foundations. When the new building was constructed, the inadequate fill/compaction led to water intrusion problems and questionable bearing. We require that the testing and inspections laboratory be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved.
  - 1. The owner shall be aware that this additional testing inspection scope will be required.
  - 2. The general contractor shall inform the demolition contractor(s) that the infill of the demolished foundations will be required to meet the earthwork requirements and be testing for compliance and any additional cost associated with ensuring the infill meets these parameters shall be included in their base bid.

**END OF SECTION 01 45 23**



## SECTION 01 45 29

### INSPECTION AND TESTING LABORATORY SERVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION (refer to Document AB for substitutions).

- A. All third-party inspection and testing laboratory services will be provided and paid for by the Owner or by allowance in this contract. An inspection and testing lab will be selected by the Owner and the Contractor will be notified as soon as possible.
- B. The Owner will pay for the initial inspection and testing laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for re-inspection and re-testing of materials that do not comply with the requirements of the Contract Documents, and for re-inspection and re-testing due to “no-shows” and cancellations by Contractor or Subcontractors.
- C. The Contractor shall coordinate and cooperate with the inspection and testing laboratory in all matters pertaining to the work. The Owner retains the option to add to or delete any or all inspection and testing specified herein.
- D. The third-party inspection and testing laboratory services are for the Owner’s benefit. These services shall in no way relieve Contractor of Contractor’s responsibility to provide quality control of all materials incorporated into the Work.
- E. Contractor may be subject to reimbursing owner if the Contractor’s means and methods are shown to cause an overrun in the Owner’s contract with testing lab.
- F. Prior to or during the pre-construction meeting, Contractor shall coordinate with the District’s selected testing lab in order to ensure proposal costs are not exceeded and schedule is congruent to testing proposed. Failure to coordinate may result in backcharges if overages are realized.
- G. Contractor shall submit a construction schedule at time of bid for the testing lab’s use.
- H. Contractor shall allow for in their proposal the coordination and supervision of tests to be performed by an independent laboratory as selected by the Owner.

##### 1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals or public authorities.
- B. Respective Sections of Specifications. Certification of products.
- C. Each Specification Section Listed: Inspection and laboratory test required and standards for inspection and testing.
- D. Testing laboratory inspection, sampling and testing are required for, but not limited to the following:
  - 1. Division 31 - Earthwork
  - 2. Section 03 30 00 - Cast-In-Place Concrete
  - 3. Section 05 31 23– Steel Roof Decking
  - 4. Section 04 20 00 - Unit Masonry
  - 5. Section 05 12 00 - Structural Steel
  - 6. Section 07 52 19 - Modified Bituminous Membrane Roofing System

7. Division 23 - Mechanical (Inspection and testing of welds and bolts on mechanical piping)  
As requested by the Owner, Architect, or Engineer.

### **1.3 AUTHORITIES AND DUTIES OF THE LABORATORY**

- A. The inspection and testing laboratory is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Specifications, or to approve or accept any portion of the Work. When it appears that the material furnished or work performed by the Contractor fails to fulfill specification requirements, the inspection and testing laboratory shall promptly notify the Owner, General Contractor, Architect, Engineers, supplier and/or subcontractor providing or preparing the materials or work being tested of such deficiencies.
- B. The inspection and testing laboratory shall promptly distribute copies of the laboratory test and inspection reports. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor. The Structural Engineer, Civil Engineer, MEP Engineer, concrete supplier, and any outside consultants shall receive copies of the testing results regarding their particular phase of the Project. Consult with Owner to determine Owner's preference of distribution (hard copy, electronic, etc.).
- C. The testing laboratory shall provide testing services under a separate agreement with the Owner or Architect, who shall be responsible for the costs of initial testing – pass or fail.
  1. The Contractor shall be responsible for costs of all re-tests required to achieve passing results.
  2. The Contractor shall be responsible for charges of the testing lab for expenses incurred for cancelled and/or mis-scheduled testing requests.
  3. The testing lab shall invoice Contractor direct for all re-tests of failed initial tests; and send copies of the invoices to the Architect and Owner for record.
  4. The testing lab and Contractor shall be responsible to negotiate and execute a separate agreement if required by the testing lab for charges described above.
- D. The testing lab is required to furnish a report of the status of testing performed as it relates to anticipated expenses described in the Agreement with the testing lab. Reports shall be furnished at most bi-monthly to the Owner and Architect.
  1. Report information shall include verification that Owner paid testing progress corresponds with anticipated expenses.
  2. The testing lab shall be required to notify the Architect and Owner immediately in writing if/when the testing lab anticipates exceeding the line item and or lump sum fee agreed by Owner.
  3. Such notification must occur prior to expensing 75% of the testing lab fee.

### **1.4 TESTING LABORATORY GUIDELINES AND PROCEDURES**

- A. Technicians scheduled to perform specific inspection and testing services must be qualified to review and perform other services that overlap, i.e., earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the Project site.
- B. Concrete design mixes will receive a cursory review with any discrepancies reported to the Architect/Engineer. No compensation will be considered for these reviews.
- C. Nuclear density testing will be based on a daily rental rate for the actual testing equipment, compensation on a per test basis will not be considered.
- D. Report distribution shall include the Owner, Architect, Contractor, Civil Engineer, Structural Engineer, and others requesting or requiring review of the specific testing results.

- E. Cylinders will be pick-up by the technician performing test the next day in order to have them cure under laboratory conditions.
- F. Structural steel inspections shall include a plant visit reviewing shop fabrication, welding, and an overall review of the shop fabrication quality control standards.
- G. The Contractor shall bear the responsibility of scheduling all the inspection and testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the inspection and testing services. Cancellations and or failed test will be reimbursable to the Owner by the Contractor. Contractor will provide and maintain a sign-in sheet for testing lab services.
- H. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for any hours over eight hours spent at the job site on a single day, field testing services performed on a Saturday or Sunday, and any field services performed on a recognized holiday.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 – EXECUTION**

### **3.1 GENERAL**

- A. Inspection and testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.
- B. Where requirements of this Section are in conflict with requirements noted on the Contract Drawings or other Sections of the Specifications, the more stringent requirement shall apply, unless directed otherwise by Architect.
- C. Should any unusual conditions be encountered during any operations, the laboratory shall be contacted immediately so that additional inspection and testing, as applicable, can be provided.
- D. The Owner reserves the right to add to or delete any or all inspection and testing specified herein.

### **3.2 SITE GRADING**

- A. Testing Services:
  - 1. Perform field tests for moisture density properties.
    - a. In each compacted fill layer, provide one (1) field test for every 5,000 square feet of area, but not less than three (3) tests.
    - b. At paved area, provide one (1) field test for every 5,000 square feet, but not less than three (3) tests.

### **3.3 COMPACTING FILL AND BACKFILL**

- A. Testing Services:
  - 1. Perform field test for moisture density properties:
    - a. Within the building line provide one (1) field test in each compacted layer for every 5,000 square feet of area, but not less than three (3) tests.

### 3.4 PAVING

- A. Testing Services:
  - 1. Perform field tests for moisture density properties:
    - a. Provide field testing of the sub-grade as described in Paragraph 3.2, A, 2 above.
    - b. Paving sub-base, provide one (1) field test for every 5,000 square feet of area of crushed limestone or caliche sub-base, if any.
    - c. Lime treated sub-grade, provide one (1) field test for every 5,000 square feet of area of lime treated sub-grade, if any, for content of lime and sub-grade compaction.
    - d. Cement soil stabilization, if any, provide one (1) field test for every 5,000 square feet of area of cement stabilized sub-grade for content of cement and sub-grade compaction.

### 3.5 PIPED SITE UTILITIES

- A. Inspection and Observation Services:
  - 1. Inspection of trenches for proper alignment and grade.
  - 2. Inspection of pipe bedding and supports.
  - 3. Inspection of pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
  - 4. Inspection of installation of pipe and joints.
  - 5. Observation of testing of piped utilities performed by Contractor.

### 3.6 EARTHWORK

- A. Inspection and Observation Services:
  - 1. Refer to and include, as applicable, work of Paragraphs 3.2, 3.3, 3.4, and 3.5 above.
  - 2. When perimeter and underfloor drainage systems are specified or required, inspect installation of such systems for conformance with specified materials and detail requirements.
  - 3. When temporary drainage and dewatering systems are used to keep excavations dry, inspect the systems for adequacy. Ground water should be maintained at least two (2) feet below bottom of excavation.
  - 4. Review the equipment and methods used in placement and compaction of fill materials and inspect materials used and compaction of fills in general earthwork and in backfilling around structures, and in backfilling in utility trenches.
  - 5. Notify the Contractor in writing and the Architect/Owner immediately if footings and slabs-on-grade are placed on unfinished soil or frozen ground and when footings and slabs-on-grade are not protected from frost damage.
  - 6. Notify the Architect/Owner when soil with allowable bearing capacity noted is encountered at elevation above the bottom of footing shown.
  - 7. Notify the Architect/Owner and Contractor if soil with required bearing capacity noted is not encountered at bottom of footing elevation shown. Bottom of footing shall be adjusted as recommended and approved by the Structural Engineer and Architect.
  - 8. Review rock excavation techniques, if required, and monitor blasting induced ground motions, as appropriate.
  - 9. Review calculations and shop drawings for sheeting, shoring, and underpinning prepared by the Contractor, if required.
- B. Testing Services:
  - 1. References (As applicable for tests):
    - a. ASTM International (ASTM)
      - 1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))
      - 2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth)
      - 3) D4318, Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- b. American Association of State Highway and Transportation Officials (AASHTO)
    - 1) T89, Determining the Liquid Limit of Soils
    - 2) T90, Determining the Plastic Limit and Plasticity Index of Soils
    - 3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305-mm (12-in) Drop
    - 4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth)
  2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab-on-grade, and backfills.
  3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
  4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
  5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material.
  6. Perform one (1) in place density test for each 2,500 square feet (280 square yards) of existing subgrade material.
  7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one (1) type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
  8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one (1) test for each 2,500 square feet (280 square yards) of each lift of compacted fill.
- C. Reports: Submit reports to Architect/Owner with the following information:
1. Type and condition of soil at footing bottoms.
  2. Level of water table in the excavated areas.
  3. Grain size distribution of fill materials (average of three (3) tests).
  4. Moisture density test results.
  5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
  6. Notify Architect/Owner by telephone within one (1) hour of the discovery of the following conditions and follow up telephone notification with written report.
    - a. Materials used, or degree of soil compaction not meeting specified requirements.
    - b. Frost and freeze protection requirements for excavation bottoms not being complied with.
    - c. Water in excavations which is not being removed prior to work being performed in excavation.

### 3.7 DRILLED AND UNDERREAMED (BELLED) PIERS

- A. Inspection and Observation Services:
1. Provide full time services for the review of all drilled pier foundation inspections. Including a daily report noting grid lines and locations of each pier drilled. After the foundation shaft has been drilled, the lab shall test an undisturbed sample and verify that it meets or exceeds the design specification.
  2. The drilling and verification of suitable soil for bearing capacity. Notify the Architect when soil with allowable bearing capacity noted is encountered at elevation above the bottom of pier shown. Notify the Architect and Contractor if soil with required bearing capacity noted is not encountered at bottom of pier elevation shown. Bottom of pier shall be adjusted as recommended and approved by the Structural Engineer and Architect.
    - a. Drilled shaft has been drilled plumb and within specified vertical and horizontal tolerances specified by the Structural Engineer.

- b. Drilled shaft and underreamed bells are excavated to specified depths and/or if conditions differ from those presented, to notify the Structural Engineer.
- c. Drilled shaft and underreamed bell bottoms are kept dry at all times, cleaned of excess cuttings, or all obstructions prior to placing reinforcing steel and concrete. If groundwater seepage occurs, it shall be removed prior to concrete placement or controlled with temporary steel casing to maintain the shaft integrity up to the concrete placement.
- d. Concrete reinforcing steel shall be checked for type, size, adequate placement and lap lengths, and doweled bars.

### **3.8 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES**

#### **A. Inspection and Observation Services:**

- 1. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with Contract Documents and approved shop drawings. All instances of noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and then, if uncorrected, reported to the Architect/Owner.

#### **B. Reports:**

- 1. Observe and Report on the Following:
  - a. Number and size of bars.
  - b. Bending and lengths of bars.
  - c. Splicing.
  - d. Clearance to forms including chair heights.
  - e. Clearance between bars or spacing.
  - f. Rust, form oil, and other contamination.
  - g. Grade of steel.
  - h. Securing, tying, and chairing of bars.
  - i. Excessive congestion of reinforcing steel.
  - j. Installation of anchor bolts and placement of concrete around such bolts.
  - k. Fabrication of embedded metal assemblies, including visual inspection of all welds.
  - l. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.

#### **C. Testing Services:**

- 1. Will be required of all suspect materials or workmanship at the discretion of the Architect, Engineer, or Owner.

### **3.9 REINFORCING STEEL MECHANICAL SPLICES**

#### **A. Inspection and Observation Services:**

- 1. Visually inspect and report on the completed condition of each mechanical splice of reinforcing steel.
- 2. Each mechanical splice shall be visually inspected to ensure compliance with the I.C.B.O. reports and the manufacturer's published criteria for acceptable completed splices.
- 3. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the I.C.B.O. Report.

- B. Reports: Submit reports to Architect with the following information:
  - 1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
  - 2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Reasons for rejection shall be shown on each report.

### 3.10 CAST-IN-PLACE CONCRETE

- A. Inspection and Observation Services:
  - 1. Review concrete design mixes proposed for use on the Project.
  - 2. Provide full time services for all structural building concrete in drilled piers, grade beams, slab on grade, columns, concrete paving, and other miscellaneous structural concrete. Refer to and include work for reinforcement steel specified in Paragraphs 3.8 and 3.9 above.
  - 3. On the first day's batching of each type and each strength of concrete, inspect and observe materials for concrete, batch weights, moisture content, and gradation of fine and coarse aggregate.
  - 4. Provide additional inspection if the Contractor elects to use concrete from more than one (1) source of supply simultaneously. All costs for such additional inspection shall be borne by the Contractor.
- B. Testing Services:
  - 1. References (As applicable for field and laboratory tests):
    - a. American Concrete Institute (ACI)
      - 1) 214, Recommended Practice for Evaluation of Strength Test Results of Concrete
      - 2) 318, Building Code Requirements for Reinforced Concrete
    - b. ASTM International (ASTM)
      - 1) C31, Practice for Making and Curing Concrete Test Specimens in the Field
      - 2) C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
      - 3) C138, Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
      - 4) C143, Slump of Hydraulic Cement Concrete
      - 5) C173, Air Content of Freshly Mixed Concrete by the Volumetric Method
  - 2. Compression Test Cylinders:
    - a. Make, transport, cure and test six (6) inch or (4) inch diameter by 12-inch-long test specimens taken from concrete being cast. Test cylinders will be made, handled, cured, and stored in accordance with ASTM C31, at the rate of four (4) cylinders minimum for each 50 cubic yards slab on grade or elevated slab four (4) cylinders minimum for each 100 cubic yards paving or fraction thereof of each class of concrete placed in any one (1) day.
    - b. Handle newly made cylinders carefully to avoid cracking the green concrete. Store these cylinders in a box at temperatures between 60 degrees F and 80 degrees F during first 24 hours. Contractor shall construct a suitable box and provide heat or cooling, if necessary, to maintain cylinders at proper temperature.
    - c. Place cylinders in laboratory storage, with molds removed, under moist curing conditions and temperature of 73 degrees plus or minus three (3) degrees F 24 hours after casting maintain these moist curing conditions until specimens are tested.
    - d. Of the test cylinders taken per 50 cubic yards or fraction thereof, test one (1) at seven (7) days and two (2) at 28 days after casting date. Store one (1) cylinder for testing at 56 days in the event the 28 days strength tests do not meet strength requirements. Test cylinders in accordance with ASTM C39. When Type III cement is used, test at three (3) days instead of seven (7) days.

- e. Each 28-day compression test report shall clearly indicate average strength results, concrete slump and air content, concrete and ambient air temperatures, and how much water was added on site by contractors as of the report date and for the class of concrete being reported.
  - f. Maintain a moving average for compressive strength based on the three (3) latest 28-day test results to check compliance with specification requirements. The figures for the standard deviation and moving average for strength will be kept continuously up to date and submitted on a weekly basis to the Architect and Engineer. Maintain a continuously up to date log in both graphical and tabulated form for each class of concrete.
    - 1) the average of the latest three (3) test results;
    - 2) the lowest average of three (3) consecutive test results recorded to date;
    - 3) the average of all sets of three (3) consecutive test results;
    - 4) the percentage of tests falling below specified strength;
    - 5) the lowest single test result.
  - g. Maintain a moving average for range of test results for quality control purposes as described in ACI 214, Chapter 4, Paragraphs 4.4 and 4.5. Graphical reports of moving average for range shall be submitted to the Architect and Engineer on a weekly basis.
  - h. Slump Tests: Conduct in accordance with ASTM C143; one (1) test shall be performed for each sampling for strength tests. Slump shall be considered acceptable if the field test is within the range of design slump plus or minus one (1) inch. For concrete placed by pumping, one (1) test shall be performed at the pump and one (1) at the point of deposit. Slump loss through pumping will be acceptable to the Architect and Engineer. Slump measured at the pump shall be evaluated for acceptance relative to the design slump in accordance with the criteria previously specified.
  - i. Air Content Tests: Conduct in accordance with ASTM C173; test air entrained concrete only, one (1) test shall be performed for each sampling for strength tests. Air content shall be considered acceptable if the field test is in the range of the design air content plus two (2) percent.
  - j. Unit Weight Tests: Conduct in accordance with ASTM C138; test each sample of lightweight concrete taken for strength tests. Unit weight shall be considered acceptable if the field test shows a fresh unit weight equal to the design unit weight plus or minus 2 pcf.
  - k. Chloride Tests: Perform one (1) total chloride ion test for each class of concrete placed each day. If the total chloride ion content is determined to be excessive by the Architect or Engineer, water soluble chloride ion tests shall be performed at the Contractor's expense.
3. Noncompliance: In the event the initial tests above indicate that concrete may not meet the specified requirements, the Architect or Engineer may, at his discretion, order additional tests be performed at the Contractor's expense. Load tests shall comply with requirements of ACI 318.

### 3.11 MASONRY

- A. Inspection and Observation Services:
  - 1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
  - 2. Review mortar design mixes.
  - 3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.
- B. Testing Services:
  - 1. References (As applicable for tests required):
    - a. ASTM International (ASTM)



- 1) C140, Standard Test Methods of Sampling and Testing Concrete Masonry Units
  - 2) C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
  - 3) C1019, Standard Test Method for Sampling and Testing Grout
  - 4) E447, Standard Test Methods for Compressive Strength of Laboratory Constructed Masonry Prisms
2. Testing of Concrete Masonry Units (CMU):
- a. Preconstruction: Perform the following tests in accordance with ASTM C140.
    - 1) Compressive Strength
    - 2) Absorption
    - 3) Weight
    - 4) Moisture Content
    - 5) Dimensions
3. Mortar Tests:
- a. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
    - 1) 28 Day Compressive Strength
    - 2) Water Retention
  - b. Construction: Perform 28-day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
4. Refer to and include work for reinforcing steel specified in Paragraphs 3.5 and 3.6 above.
5. Grout Tests:
- a. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
    - 1) Slump Test
    - 2) 28 Day Compressive Strength
    - 3) Construction: Perform 28-day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
    - 4) Prism Test: Perform preconstruction 28-day compressive strength test on concrete masonry walls in accordance with ASTM E447, Method B.

### 3.12 STRUCTURAL STEEL

- A. Inspection Services:
1. General:
    - a. Review submittals from fabricator.
    - b. Review all shop and field welder's qualifications.
  2. Structural Steel, Steel Joists and Mechanical Piping:
    - a. Shop inspect each member for defects such as cracks, excessive camber, deformation, and specified surface preparation prior to shop priming or galvanizing.
    - b. Inspect shop priming for coverage and measure of mil thickness.
    - c. Perform visual inspection of all welds; measure 15 percent of welds.
    - d. Inspect size and placement of anchor bolts in concrete and masonry.
    - e. Verify that erector surveys plumbness of each column.
    - f. Verify that erector inspects alignment of beams, shelf angles, lintels, joists, joist girders, and other similar supporting members.
    - g. Perform visual inspection of bolts to determine that the method(s) used are in conformance with the Contract Documents.
  3. Metal Decks:
    - a. Field inspect material for type, gauge, finish and other requirements of the Contract Documents.
    - b. Field inspect installation methods including welding, alignment, joints, laps, and flatness, and all other requirements of the Contract Documents.

4. Steel Stud Shear Connectors:
  - a. Field inspect installation methods and welds.
  - b. Verify number of studs, stud placement and length for conformance with the Contract Documents.
  
- B. Testing Services:
  1. References (As applicable for tests required):
    - a. American Institute of Steel Construction (AISC)
      - 1) Specifications for Structural Joints Using ASTM A325 or A490 Bolts
    - b. ASTM International (ASTM)
      - 1) A6, General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
      - 2) A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
      - 3) A490, Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
    - b. American Welding Society (AWS)
      - 1) D1.1, Structural Welding Code, Steel
  2. Structural Steel:
    - a. Perform all tests required by Structural Welding Code and authorities having jurisdiction.
    - b. Ultrasonically test all edges of material greater than 1-1/2 inch thick that is to be welded for evidence of laminations, inclusions, or other discontinuities. The extent to which such defects will be permitted, and the extent of repair permitted shall be in accordance with ASTM A6.
    - c. The root layer of all multiple pass welds and the backside of groove welds made from both sides, after back gouging or chipping, shall be tested by magnetic particle or dye penetration if magnetic particle is not feasible.
    - d. Fillet welds for beam and girder shear connections (15 percent at random) shall be tested by magnetic particle for final pass only.
    - e. Fillet welds for plate girder flange/web connections shall be tested by magnetic particle for final pass only.
    - f. Ultrasonically test 100 percent of full penetration welds.
    - g. Ultrasonically test 100 percent of partial penetration column splice welds.
    - h. Test 100 percent of continuity plate fillet welds by magnetic particle for final pass.
    - i. Perform all equipment calibrations and production tests of high strength bolt connections as required by AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
    - j. Randomly sample bolts, nuts, and washers from the Project Site at a rate sufficiently to test and verify compliance with ASTM Standards.
    - k. When bolts are tightened by “turn-of-the-nut” method, check by calibrated torque wrench 25 percent of bolts in each shear connection, but not less than two (2) bolts per connection.
    - l. In addition, provide at least one (1) test per 50 linear inches of weld by each welder, except that 100 percent of full penetration welds shall be tested using approved radiographic, magnetic particle, or ultrasonic method. Tolerance for welds shall be in accordance with the requirements of AWS D1.1 and the Contract Drawings.
    - m. Perform tension tests on steel in accordance with ASTM A6, if required.
    - n. Perform load tests on structural members in place, if required.
  3. Steel Stud Testing:
    - a. Test not less than ten (10) percent of studs on any beam, plus all studs indicating imperfections. Studs will be considered imperfect if, after welding, visual inspection reveals:
      - 1) Studs lacking full 360-degree weld.
      - 2) Studs which have been repaired by welding.

- b. Studs shall be tested by striking with a hammer and bending to approximately 15 degrees off vertical. Bend studs lacking full 360 degrees weld in a direction opposite to the side lacking the weld. Replace studs that crack after this test either in the weld or the shank. Studs meeting this test will be considered acceptable and left in place.

### 3.13 SPRAYED-ON FIREPROOFING

- A. Inspection Services:
  1. Inspection of sprayed-on fireproofing to ascertain compliance with Contract Documents.
- B. Testing Services:
  1. References (As applicable for tests required):
    - a. ASTM International (ASTM)
      - 1) E605, Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
      - 2) E736, Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
  2. Perform tests on sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
  3. Perform tests on sprayed-on fireproofing for cohesion and adhesion in accordance with ASTM E736.

### 3.14 LIGHTWEIGHT INSULATING CONCRETE FILL

- A. Inspection and Observation Services:
  1. Inspection of roof deck prior to start of work.
  2. Inspection during installation of insulation and lightweight insulating concrete fill work to ascertain compliance with Contract Documents.
  3. Observation of base ply fastener pull tests performed by Testing Lab to ascertain minimum withdrawal resistance of 40 pounds per square foot per fastener, based on ANSI/SPRI Protocol. Architect and Roofing Inspector to witness fastener pull tests.
- B. Testing Services:
  1. References (As applicable for tests required):
    - a. ASTM International (ASTM)
      - 1) C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded-Hot-Plate Apparatus
      - 2) C495, Test Method for Compressive Strength of Lightweight Insulating Concrete
      - 3) C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation
  2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
  3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
    - a. Mix design compressive strength.
    - b. Mix design wet and dry density range.
    - c. Number of Tests:
      - 1) One (1) per 5,000 square feet
      - 2) Not less than one (1) for each day's work
  4. Test EPS insulation board for density in accordance with ASTM C578.

### 3.15 ROOFING SYSTEM

- A. Inspection and Observation Services:
  1. Attend pre-construction meeting prior to Contractor starting work.

2. Attend pre-installation meetings for decking, lightweight concrete, roofing, and sheet metal installations.
3. Review field mockups of sheet metal and other components as applicable.
4. Inspect on-site condition of stored roofing materials
5. Provide full-time roofing inspector during the following stages of construction:
  - Final stages of metal deck attachment
  - Lightweight concrete roof deck application
  - Modified bitumen roofing and metal roofing application
6. Provide spot inspections for sheet metal work and thru-wall flashing. Thru-wall flashing shall be left open by the Contractor until inspected, and sheet metal shall not be covered until inspected.
7. Witness water tests and pull tests completed by others.
8. Observe roof test cuts, and patching of cuts, performed by Contractor to ascertain that they are properly made.
9. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.
10. Provide a written daily report in standardized format to Owner within 72 hours of inspection. The report shall describe all roofing-related activities as well as recommendations made to Contractor by the Inspector. The report shall also include a running list of items from previous reports that have not yet been addressed by Contractor. The reports shall also include an itemization of items that should be backcharged to the Contractor. Submit report to Contractor, Architect, and Owner.
11. Provide and maintain a sign-in sheet in the construction trailer. **Inspector shall sign in and out for every inspection, or Owner will not pay for that inspection.**
12. Attend the punch list walk and provide a written punch list of all roofing components to Architect and Owner.
13. Conduct a final inspection of all roofing components and provide Owner with a letter confirming that all punch list items are complete.
14. Review Siplast Warranty and provide a letter to the Owner confirming that it is correct and complete.

### 3.16 GLAZED SYSTEMS, TRANSLUCENT WALL PANEL SYSTEMS AND SKYLIGHTS

- A. Testing Services:
  1. Perform air and water infiltration testing on initial installation of each exterior glazed system, translucent wall panel system and skylight to ascertain compliance with specifications.

## PART 4 – GENERAL – PROJECT CONSULTANT OBSERVATIONS

### 4.1 DESCRIPTION

- A. The Contractor shall include in his Proposal the coordination and scheduling of Observations to be performed by the Owner and Architect's project consultants, as they may apply to this work.
- B. All project consultant observation services shall be performed by designees of the relative consultant; upon which the Contractor may rely as to the capability and thoroughness of the observation being performed. Upon request by the Contractor, the names of inspectors performing specific observations shall be furnished by the Architect.
- C. The Owner shall pay for the observation services of the project consultants in accordance with the Owner / Architect Agreement and the requirements of the Contract Documents. Excessive observations and re-observations resulting from the Contractor's actions as described in paragraph 4.4 below, shall be paid for by the Contractor directly to the affected Consultant.

- D. The Contractor shall cooperate with the Owner's project consultants in all matters pertaining to required observations of the work as described in the Contract Documents. The Owner retains the option to add to or delete any or all observations specified herein; and thereby accept the relative work without observation.

#### **4.2 RELATED REQUIREMENTS**

- A. Conditions of the Contract, AIA Document A201 as amended, and Supplementary Conditions to the General Conditions for the Construction Contract, Specification section CA.
- B. Respective Sections of Specifications describing the required consultant observations.

#### **4.3 AUTHORITIES AND DUTIES OF THE PROJECT CONSULTANT INSPECTORS**

- A. The project consultant inspectors are not authorized to revoke, alter, relax, increase, or release the Contractor from any requirement of the Contract Documents without written notice furnished to the Contractor by the Architect. When it appears that the material, assembly or work performed by the Contractor fails to fulfill Contract requirements, the project consultant inspector shall promptly notify the General Contractor, Architect and Owner.
- B. The project consultant inspector(s) shall distribute copies of the observation reports within two (2) working days. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor.

#### **4.4 PROJECT CONSULTANT OBSERVATION GUIDELINES AND PROCEDURES**

- A. Project Consultants shall make all observations required in the Contract Documents and requested by the Architect, Contractor and/or Owner.
- B. For each material, assembly or phase observation required in the Contract Documents, and upon request by the Contractor, the project consultant(s) shall perform the following observations as required in the Owner – Architect Agreement:
  - 1. Initial observation to determine compliance with the Contract Documents.
  - 2. Observation to determine deficiencies where the initial observation results do not show 100% compliance with the Contract Documents. At the consultant's discretion, this observation may be performed concurrent with the initial observation.

The above series of observations shall be at the expense of the Owner in accordance with the Owner/Architect Agreement. If re-observation is required to determine 100% compliance is required, it shall be at Contractor's expense.

- C. In the event the observation series described above does not result in 100% approval of the material, assembly or phase being inspected, all subsequent re-observations required to achieve 100% approval shall be at the sole expense of the Contractor to be paid to the project consultant (via Owner backcharge to the Contractor) based on the consultant's standard hourly rates for time expended, including travel to and from the site.
- D. Recognizing the size and complexity of work included in a project may be sufficiently large enough to require the project to be divided into scope areas, each such area shall be considered separate and stand-alone with respect to paragraph 4.4.B above. Requests by the Contractor for project consultant observations of partial scope areas shall be considered observations of the entire scope area with respect to paragraph 4.4.B above; and subsequent observations of the remaining portions of the same scope area shall be paid for by the Contractor (via Owner backcharge to the Contractor). Owner shall invoice the Contractor on a monthly basis, and payment shall be due upon the Contractor's receipt of the invoice.

- E. The Contractor shall bear the responsibility of requesting and scheduling all project consultant observations required by the Contract Documents. The Contractor shall give the project consultant a minimum of forty-eight (48) hours' notice prior to the requested observation. No extension of Contract Time shall be granted for untimely observations due to the Contractor's failure of proper observation request notification.
- F. Observations voluntarily made by project consultants at their discretion, not specifically requested by the Contractor, shall not count as one of the observations described in paragraph B above, nor shall the Contractor be liable for any related expenses.

#### **4.5 PROJECT CONSULTANT OBSERVATIONS**

- A. Earthwork
- B. Site Utilities prior to cover-up
- C. Concrete Reinforcing
- D. Cast-in-place concrete
- E. Structural steel
- F. All Building Envelope assemblies
- G. Mechanical rough-in prior to cover-up
- H. Plumbing rough-in prior to cover-up
- I. Electrical rough-in prior to cover-up
- J. Above ceiling prior to cover-up
- K. Start-up demonstrations of building systems and components
- L. Punch lists (treated separately for each architect and consultant). Refer to Specification Section CA, section 9.8
- M. Observation / review of O&M Manuals and other close-out documents
- N. Observation / review of Record Drawings

#### **4.6 PROJECT CONSULTANT HOURLY RATES**

- A. Refer to the A201 General Conditions of the Contract for Construction, as Amended Article 8 for applicable hourly rates.

### **PART 5 – GENERAL – GOVERNMENTAL INSPECTIONS**

#### **5.1 DESCRIPTION**

- A. The Contractor shall include in his Proposal the application, coordination, scheduling and cost of all on-site inspections to be performed by governmental authorities having jurisdiction which are required for approval of the Work and occupancy of the building; including, but not limited to all City departments, all County departments, Flood Control Districts, Municipal Utility Districts, utility provider, Health Departments and Fire Marshal Offices.

- B. The Contractor shall make all corrective measures in accordance with instructions received from the governing authority inspector having jurisdiction, as required to receive 100% approval for the work being inspected.
- C. The Contractor shall bear all costs for initial inspections, re-inspections and any other expenses related to on-site inspections made by governing authority.
- D. No allowance shall be made for additional Contract Time, nor an increase in the Contract Sum for any unanticipated expenses or delays resulting from failed governmental inspection or resulting re-inspections required to obtain approval(s).

**5.2 EXCLUSION**

- A. The Contractor shall not be responsible for making application, coordination, inspections and receiving approval of the Work by the Texas Department of Licensing and Regulation relative to ADA and Texas Accessibility Standards.

**END OF SECTION**

## SECTION 01 50 00

### TEMPORARY FACILITIES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.
- B. Temporary facilities shall only be for the duration of construction, unless noted otherwise, and all temporary facilities shall be completely removed at the completion of the project. Any areas disturbed by the placement of temporary facilities shall be repaired/replaced to a finished condition consistent with the surrounding finished area.

##### 1.2 UTILITIES

- A. The Contractor shall supply temporary job power, drainage outfall, sanitary sewer, and water hook-ups for site. The Contractor shall provide all wiring, lamps, distribution of power and similar equipment as required for construction, inspection, and testing of each project.
- B. The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.
- C. The General Contractor shall provide temporary heat to prevent freezing and maintain proper temperatures to avoid damage to materials in the building and allow work to continue in such weather conditions. The General Contractor shall provide and maintain such dependable source of supply, such as heat, as may be necessary until the building is accepted.
- D. The Contractor will be required to provide temporary water and electrical connections for field sprinkler systems after Substantial Completion of the fields. These connections must be maintained through the duration of the Contract, or until permanent connections are made.
- E. Any utility usage at existing buildings in excess of 110% of historical usage for the previous 12-month period shall be paid by the Contractor.

##### 1.3 FIELD OFFICE

- A. The Contractor will be required to furnish a job trailer installed at a suitable location (on site at one campus), for use by the Contractor, Architect, and Owner.
- B. Provide and maintain a weather-tight building with operable and lockable door and windows, to serve as a job office available to the Contractor, subcontractors, Owner, and the Architect. Provide lights, electricity, air conditioning and heat, as required. Remove office from premises when one can be set up inside the building. Provide job site telephone, internet, and other miscellaneous items as outlined below.
  - 1. Provide a separate lockable room (120 sq. ft.) in Contractor's job trailer to serve as an office for the Architect and Owner's representative or provide in a separate building in close proximity to Contractor's office.
  - 2. Contractor's office shall be of a size, and shall be furnished, so that it may be used for small progress meetings (seating for approximately 8 persons at table).
  - 3. Provide adequate artificial lighting, heating and cooling to provide comfortable conditions for occupants.
  - 4. Provide direct line telephone service for both voice communication and internet connection.
  - 5. Furnishings Required:
    - a. Contractor's Office: Racks and files for Contract Documents and for Record Documents; conference table and chairs; and desks and chairs as required by Contractor.



- b. Architect's Office: One lay-out drafting table 36" x 72" x 36" high; one standard desk with three drawers; chair and drafting stool. Provide one drawing rack for 30" x 42" drawings.
- 6. Provide high speed data access with internet access and wireless access point/router.

#### 1.4 SANITARY FACILITIES

- A. Furnish temporary sanitary facilities and maintain in compliance with regulations of State Department of Health and other authorities having jurisdiction (minimum of one water closet and hand sink).

#### 1.5 STORAGE FACILITIES

- A. Provide and maintain adequate weathertight lockable storage facilities, raised above the ground, with sides and top enclosed.
- B. Replace materials improperly stored and damaged by weathered conditions.
- C. Remove storage facilities when materials are stored within the structure in a weathertight condition.
- D. Allow for temporary freeze protection as needed.
- E. Address any storage needs for owner equipment, furniture, etc.

#### 1.6 SIGNS

- A. Within three weeks after receipt of Notice to Proceed, provide one project identification sign and install in a location designated by the Owner at each campus.
- B. Fabricate the sign with sturdy wood framing and 3/4-inch-thick exterior grade plywood, with aluminum overlay and applied digitally printed vinyl sign, a minimum area of 64 cumulative square feet (8' x 8'). No other signs, except as allowed herein, shall be allowed to be displayed on the site. Contractor shall submit a scaled shop drawing of the sign, including all lettering, to the Owner for approval prior to installation.
- C. Project sign shall incorporate design layout as provided by Architect, and shall include:
  - 1. The official title of the Project as listed on Contract Documents.
  - 2. The name of the Owner as listed on Contract Documents.
  - 3. The names and titles of School Board Members and School Administrators.
  - 4. The names and titles of Architect.
  - 5. Identification number of the Contractor.
- D. Erect signs on 4" (102 mm) x 4" (102 mm) supports set firmly into the ground and well braced. The bottom of the sign is to be a minimum of 4' above grade, unless otherwise instructed by the Architect.
- E. Other signs required at the site:
  - 1. Warning, directional, and identification signs as required to indicate construction office location, and to facilitate campus operations that are impacted by construction.
- F. Contractor shall provide necessary signage to accommodate all Owner needs necessitated by the Work including temporary walking/driving routes, deliveries, etc.
- G. Allow no other signs to be displayed at the project site, unless authorized by the Owner.
- H. Secure and pay for all sign permits as required by local authorities.
- I. The sign shall remain the property of the Owner, and upon final completion, the Contractor shall remove the sign and deliver it to a location designated by the Owner or dispose of sign if directed by Owner.

### **1.7 BARRIERS**

- A. Provide temporary barricades on all portions of the site as required to secure the construction area and affected areas of building and site.
- B. Provide approved barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, water puddling and continuous running water.
- C. Provide temporary partitions as needed to separate work areas from building occupants.

### **1.8 SECURITY**

- A. Determine if and when watchmen are necessary for protection to the work and provide such services when necessary. Neither the provision of watchmen nor the failure to provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

### **1.9 CLEANING**

- A. **Trash Removal:** Clear the building and site daily of trash. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper and cardboard daily. Dumpsters will not be allowed to overflow and should be emptied on a regular basis. Subcontractors shall provide their own dumpsters for disposal of their debris.
- B. **Daily cleanup (renovation and new construction projects):** Daily cleanup is required both within construction area, and also for any areas on site that are used by Owner (sidewalks, drives, roads, corridors, etc.).
- C. **Disposition of Debris:** Remove debris from the site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restriction. Neither debris nor material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.
- D. Refer to Section 01 71 50 for Preventive Housekeeping.

### **2.0 TEMPORARY FIRST AID FACILITIES**

- A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.
- B. Provide a sign, posted at the telephone, listing the telephone numbers for emergency medical services: physicians, ambulance services and hospitals.
- C. Provide and maintain one Automated External Defibrillator (AED) unit throughout duration of the project.

### **2.1 TEMPORARY FIRE PROTECTION**

- A. Provide a fire protection and prevention program for employees and personnel at the site; and provide and maintain fire extinguishing equipment ready for instant use at all areas of the project, and at specific areas of critical fire hazard.
- B. **Equipment:**
  - 1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
  - 2. Barrels of water with buckets designated for fire control purposes.
  - 3. Water hoses connected to an adequate water pressure and supply system.
  - 4. Construction period use of permanent fire protection system.

- C. Enforce Fire-safety Discipline:
  - 1. Store volatile materials in an isolated, protected location.
  - 2. Avoid accumulations of flammable debris and waste in or about the Project.
  - 3. Prohibit smoking on CFISD property and in the vicinity of hazardous conditions.
  - 4. Closely supervise welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions, including roofing torching operations.
  - 5. Supervise locations and operations of portable heating units and fuel.
- D. Maintain fire extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.
- E. Contractor shall coordinate and comply with all requirements of Owner's personnel, as well as those of governing authorities.

## **2.2 CONSTRUCTION AIDS**

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the work; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.
- B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.
- C. Maintain all equipment in a first-class, safe condition.

## **2.3 ACCESS ROADS AND PARKING AREAS**

- A. Submit to CFISD for review and upon written approval, provide adequate temporary roads and walks to achieve all-weather car access into the site from public thoroughfares, and within and adjacent to the site, as necessary to provide interrupted access to field offices, work and storage areas. All temporary access roads and walks shall be removed upon completion of permanent facilities, or completion of construction.
- B. Provide adequate parking space for personnel and employees at the site, located to avoid interference with traffic adjacent school facilities and functions, work or storage areas, or with materials-handling equipment.
- C. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

**END OF SECTION**

## **SECTION 01 55 26 - TRAFFIC CONTROL AND REGULATION**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.
- B. Qualifications and requirements for use of flagmen.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Price Contracts.
  - 1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.
  - 2. Flagmen. Payment for flagmen is on a lump sum basis. Partial payments will be based on Contractor's Schedule of Values for flagmen.
  - 3. New Portable Concrete Low Profile Traffic Barrier Provided. Payment is on a unit price basis for each linear foot of low profile traffic barrier provided, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
  - 4. Portable Concrete Low Profile Traffic Barrier picked up from Stockpile. Payment is on a unit price basis for each linear foot of low profile traffic barrier picked up from designated stockpile, moved onto the project, set at location and connected together.
  - 5. Portable Concrete Low Profile Traffic Barrier Installed. Payment is on a unit price basis for each linear foot of low profile traffic barrier delivered to the project location, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.
  - 6. Portable Concrete Low Profile Traffic Barrier Moved and Reset. Payment is on a unit price basis for each linear foot of low profile traffic barrier disassembled, moved on the project, reset at the new locations and connected together. Include cost to repair roadway in the unit price.
  - 7. Portable Concrete Low Profile Traffic Barrier Removed. Payment is on a unit price basis for each linear foot of low profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Division 1. Include cost to repair roadway in the unit price.
  - 8. Refer to Division 1 for unit price procedures.
- B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

#### **1.3 REFERENCES**

- A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)
- B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

#### 1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Traffic control plan:
  - 1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.
  - 2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.
- C. Submit copies of approved lane closure permits issued by all governmental authorities.
- D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.
- E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

#### 1.5 FLAGMEN

- A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes.
- B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.
  - 1. Uniformed Peace Officers may be:
    - a. Sheriffs and their deputies;
    - b. Constables and deputy constables;
    - c. Marshals or police officers of an incorporated city, town or village; or
    - d. As otherwise provided by Article 2.12, Code of Criminal Procedure.
  - 2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.
- C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:
  - 1. Formally trained and certified in traffic control procedures by the City's E. B. Cape Center.
  - 2. Speaks English. Ability to speak Spanish is desirable but not required.
  - 3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the City of Houston's Wage Scale for Engineering Construction.
- D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

## **PART 2 PRODUCTS**

### **2.1 SIGNS, SIGNALS, AND DEVICES**

- A. Comply with TMUTCD requirements.
- B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

### **2.2 PORTABLE LOW PROFILE CONCRETE BARRIERS**

- A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

## **PART 3 EXECUTION**

### **3.1 PUBLIC ROADS**

- A. Submit requests forms for lane closure and sidewalk closure to the appropriate governmental authority at least three working days prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits.
- B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Owner's Representative.
- C. Give Owner's Representative one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.
- D. Notify police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.
- E. Maintain 10-foot-wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.
- F. Do not obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by Owner's Representative.
- G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Owner's Representative to maintain temporary driveway access to commercial and residential driveways.
- H. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with applicable ordinances.
- I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.
- J. Provide safe access for pedestrians along major cross streets.
- K. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

- L. Do not close more than two consecutive esplanade openings at a time without prior approval from Owner's Representative.

### **3.2 CONSTRUCTION PARKING CONTROL**

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Owner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

### **3.3 FLARES AND LIGHTS**

- A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

### **3.4 HAUL ROUTES**

- A. Utilize haul routes designated by authorities or shown on Drawings for construction traffic.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

### **3.5 TRAFFIC SIGNS AND SIGNALS**

- A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify the governmental agency having jurisdiction a minimum of 60 days in advance of need for control boxes and switchgear. The Contractor will pay for all necessary service, programming or adjustments, to signal boxes and switchgear if required during construction.
- B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.
- C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.
- D. Unless otherwise approved by Owner's Representative, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.
- E. Replace existing traffic control devices in Project area.
- F. Owner's Representative may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the Owner.

### **3.6 BRIDGING TRENCHES AND EXCAVATIONS**

- A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.

- B. Shore trench or excavation to support bridge and traffic.
  
- C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:
  - 1. Bridging is placed over existing bus routes,
  - 2. More than five percent of daily traffic is comprised of commercial or truck traffic,
  - 3. More than two separate plates are used for bridging, and
  - 4. When bridge is to be used for more than five consecutive days.
  
- D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

### **3.7 REMOVAL**

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of 2 feet.

### **3.8 TRAFFIC CONTROL, REGULATION AND DIRECTION**

- A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:
  - 1. Multi-lane vehicular traffic must be diverted into single lane vehicular traffic,
  - 2. Vehicular traffic must change lanes abruptly,
  - 3. Construction equipment must enter or cross vehicular traffic lanes and walks,
  - 4. Construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks,
  - 5. Traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and
  - 6. Where construction activities might affect public safety and convenience.
  
- B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

### **3.9 INSTALLATION STANDARDS**

- A. Place temporary pavement for single lane closures, in accordance with TMUTCD.
  
- B. Reinstall temporary and permanent pavement markings as approved by Owner's Representative. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Owner's Representative for approval prior to installation. No additional payment will be made for use of alternate markings.

### **3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL**

- A. Submit name, address and telephone number of individual designated to be responsible for maintenance of traffic handling at construction site to Owner's Representative. Individual must



be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.

- B. they are visible, in good working order, and conform with traffic handling plans as approved by Owner's Representative. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.
- C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.
- D. Obtain approval of Owner's Representative to reuse damaged or vandalized signs, drums, and barricades.

**END OF SECTION 01 55 26**

## **SECTION 01 57 23 - TEMPORARY STORM WATER POLLUTION CONTROL**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 G E N E R A L**

#### **1.1 SECTION INCLUDES**

- A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Division 1.
- B. Installation and maintenance of storm-water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.
- C. Filter Fabric Fences:
  - 1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
  - 2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized flow areas.
- D. Straw Bale Fence.

#### **1.2 MEASUREMENT AND PAYMENT**

##### **A. UNIT PRICES**

- 1. Payment for filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
  - 2. Payment for reinforced filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
  - 3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.
  - 4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.
  - 5. Payment for storm-water-pollution-prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping includes diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.
  - 6. Payment for straw bale barrier, if included in Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm-water-pollution-prevention structures.
  - 7. Payment for brush berm, if included in Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm water-pollution-prevention structures.
  - 8. Payment for sandbag barrier, if included in Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm-water-pollution prevention structures.
  - 9. Payment for sediment basin with pipe outlet or stone outlet, if included in Document 00410 - Bid Form, is on a square yard basis, if not include in cost of storm-water-pollution-prevention structures.
  - 10. Payment for inlet protection barriers, if included in Document 00410 - Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm-water-pollution prevention structures.
  - 11. Refer to Division 1 for unit price procedures.
- B. in this Section is included in total Stipulated Price.

### **1.3 REFERENCE STANDARDS**

#### **A. ASTM**

1. A 36 - Standard Specification for Carbon Structural Steel.
2. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)].
3. D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

- B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

### **1.4 SYSTEM DESCRIPTIONS**

- A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.
- B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.
- C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.
- D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.
- E. Sediment traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

### **1.5 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit manufacturer's catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.
- D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.
- E. Submit shop drawings for Drop Inlet Baskets.

## **PART 2 PRODUCTS**

### **2.1 CONCRETE**

- A. Concrete: Class B in accordance with Division 1 or as shown on the Drawings.

### **2.2 AGREGATE MATERIALS**

- A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.
- B. Provide gravel lining in accordance with Division 2 or as shown on the drawings.
- C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
- D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

### **2.3 PIPE**

- A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Division 2 or as shown on the Drawings.
- B. Inlet Pipes: Galvanized steel pipe in accordance with Division 2 or as shown on the Drawings.
- C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

### **2.4 GEOTEXTILE FILTER FABRIC**

- A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
- B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.
- C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.
- D. Mirafi, Inc., Synthetic Industries, or equivalent.

### **2.5 FENCING**

- A. Wire Fencing: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.
- B. Fence Stakes: Nominal 2 x 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

### **2.6 SANDBAGS**

- A. Provide woven material made of polypropylene, polyethylene, or polyamide material.
  - 1. Minimum unit weight of four ounces per square yard.

2. Minimum grab strength of 100 psi in any principal direction (ASTM D4632).
3. Mullen burst strength exceeding 300 psi (ASTM D3786).
4. Ultraviolet stability exceeding 70 percent.
5. Size: Length: 18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: 50 to 125 pounds.

## **2.7 DROP INLET BASKET**

- A. Provide steel frame members in accordance with ASTM A36.
- B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

## **2.8 STRAW BALE**

- A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

## **PART 3 EXECUTION**

### **3.1 PREPARATION, INSTALLATION AND MAINTAINANCE**

- A. Provide erosion and sediment control structures at locations shown on the Drawings.
- B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manger to remove and discard existing system.
- D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Division 1.
- E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Division 1.
- F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Division 2.

- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.
- H. Protect existing trees and plants in accordance with Division 1.

### **3.2 SEDIMENT TRAPS**

- A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
- B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.
- C. Use fill material for embankment in accordance with Division 2.
- D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.
- E. Stone outlet sediment traps:
  - 1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.
  - 2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.
- F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.
- G. Remove sediment deposits when design basin volume is reduced by one-third or sediment level is one foot below principal spillway crest, whichever is less.

### **3.3 FILTER FABRIC FENCE CONSTRUCTION METHODS**

- A. Fence Type 1
  - 1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory pre-assembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
  - 2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.
  - 3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.
  - 4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
  - 5. Backfill and compact trench.
- B. Fence Type 2
  - 1. Layout fence same as for Type 1.
  - 2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.

3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
  4. Install trench same as for Type 1.
  5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
  6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
  7. Backfill and compact trench.
- C. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.
- D. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.
- E. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
- F. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.
- G. Triangular Filter Fabric Fence Construction Methods
1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
  2. Secure triangular fabric filter fence in place using one of the following methods:
    - a. Toe-in skirt 6 inches with mechanically compacted material;
    - b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or
    - c. Trench-in entire structure 4 inches.
  3. Anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
  4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.
- H. Reinforced Filter Fabric Barrier Construction Methods
1. Attach woven wire fence to fence stakes.
  2. Securely fasten filter fabric material to wire fence with tie wires.
  3. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.
  4. Remove sediment deposits when silt reaches depth one-third height of barrier or 6 inches, whichever is less.

### **3.4 DIKE AND SWALE**

- A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.

- B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.
- C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.
- D. Clear in accordance with Division 2.
- E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

### **3.5 DOWN SPOUT EXTENDER**

- A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Division 2.

### **3.6 PIPE SLOPE DRAIN**

- A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.
- B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.
- C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.
- D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.
- E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

### **3.7 PAVED FLUME**

- A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
- B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
- C. Construct permanent paved flumes in accordance with Drawings.
- D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

### **3.8 LEVEL SPREADER**

- A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.



- B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

### **3.9 INLET PROTECTION BARRIER**

- A. Place sandbags and filter fabric fences at locations shown on the SWP3.

### **3.10 DROP INLET BASKET CONSTRUCTION METHODS.**

- A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.
- B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.
- C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.
- D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

### **3.11 STRAW BALE FENCE CONSTRUCTION METHODS**

- A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
- B. Embed bale in soil a minimum of 4 inches.
- C. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.
- D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
- E. Replace with new straw bale fence every two months or as required by Owner's Representative.

### **3.12 BRUSH BERM CONSTRUCTION METHODS**

- A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
- B. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap. Avoid incorporation of annual weeds and soil into brush berm.
- C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.
- D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

### **3.13 STREET AND SIDEWALK CLEANING**

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Division 1.

- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not water hose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

### **3.14 WASTE COLLECTION AREAS**

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

### **3.15 EQUIPMENT MAINTENANCE AND REPAIR**

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.
- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

### **3.16 VEHICLE/ EQUIPMENT WASHING AREAS**

- A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Division 1. Install gravel or rock base beneath wash areas.
- B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into watercourses or storm water conveyance systems.
- C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

### **3.17 WATER RUNOFF AND EROSION CONTROL**

- A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.
- E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.
- F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

1. Hold area of bare soil exposed at one time to a minimum.
  2. Provide temporary controls such as berms, dikes, and drains.
- G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.
- H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
- I. Dispose of sediments offsite, not in or adjacent to streams or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.
- J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.
- K. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.
- L. Do not damage existing trees intended to remain.

### **3.18 REMOVAL OF CONTROLS**

- A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Owner's Representative.
- B. Dispose of sediments and waste products following Division 1.

**END OF SECTION 01 57 23**

## **SECTION 01 57 23.10 - TPDES REQUIREMENTS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 (the Construction General Permit).
- B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other appropriate practices shown on the Drawings or specified elsewhere in the Contract.
- C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with the Owner's Representative prior to start of construction.

#### **1.2 DEFINITIONS**

- A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.
- B. Large Construction Activity: Project that:
  - 1. Disturbs five acres or more, or
  - 2. Disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.
- C. Small Construction Activity: Project that:
  - 1. Disturbs one or more acres but less than five acres, or
  - 2. Disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.
- D. TPDES Operator:
  - 1. The person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SWP3 for the site or other Construction General Permit conditions.

### **PART 2 PRODUCTS - Not Used**

### **PART 3 EXECUTION**

#### **3.1 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)**

- A. Prepare a SWP3 following Part III of the Construction General Permit and the applicable local code. If conflicts exist between the Construction General Permit and the local regulations, the more stringent requirements will apply.
- B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.

- C. Submit the SWP3 and any updates or revisions to the Owner's Representative for review and address comments prior to commencing, or continuing, construction activities.

### **3.2 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY**

- A. Fill out, sign, and date TCEQ Form 20022 Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000).
- B. Transmit the signed Contractor's copy of TCEQ Form 20022, along with a check for the required fee, made out to Texas Commission on Environmental Quality.
- C. Submission of the Notice of Intent form by the Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

### **3.3 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY**

- A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice."
- B. Transmit the signed Construction Site Notice to the Engineer at least seven days prior to Commencement of Construction Activity.

### **3.4 CERTIFICATION REQUIREMENTS**

- A. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form

### **3.5 RETENTION OF RECORDS**

- A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to the Owner's Representative.

### **3.6 REQUIRED NOTICES**

- A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:
  - 1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. A signed copy of the Contractor's NOI must also be posted.
  - 2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.
    - a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with the Owner's Representative to conform to requirements of the Construction General Permit.

- b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.
4. Post a notice of waste disposal procedures in a readily visible location on site.

### **3.7 ON-SITE WASTE MATERIAL STORAGE**

- A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.
- B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.
- C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

### **3.8 NOTICE OF TERMINATION**

- A. Submit a NOT to TCEQ and the Engineer within 30 days after:
  1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
  2. Another operator has assumed control over all areas of the site that have not been stabilized; and
  3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

**END OF SECTION 01 57 23.10**

## **SECTION 01 57 23.11 - STABILIZED CONSTRUCTION EXIT**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

#### **1.2 SUBMITTALS**

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.
- B. Sieve analysis of aggregates conforming to requirements of this Specification.

#### **1.3 UNIT PRICES**

- A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.
- B. When indicated in the Unit Price Schedule, include stabilized exits under payment for Street Cleaning as Required by NPDES, including stabilized construction roads, parking areas, exits, and truck washing areas will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, embankment and excavation, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, redressing of aggregates and stones, cleaning of streets, and removal of erosion and sediment control systems at the end of construction.

#### **1.4 REFERENCES**

- A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

### **PART 2 PRODUCTS**

#### **2.1 GEOTEXTILE FABRIC**

- A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632), and the equivalent opening size between 50 and 140.
- C. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0°F to 120°F.
- D. Representative Manufacturers: Mirafi, Inc., or equal.

**2.2 COARSE AGGREGATES**

- A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or a combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.
- B. Coarse aggregates shall conform to the following gradation requirements.

<u>Sieve Size (Square Mesh)</u>	<u>Percent Retained (By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

**PART 3 EXECUTION**

**3.1 PREPARATION AND INSTALLATION**

- A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.
- B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner's Representative to remove and discard the existing system.
- D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the Owner. Remove stabilized construction roads and exits promptly when directed by the Owner's Representative. Discard removed materials off site in accordance with the requirements of Division 1.
- E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.
- F. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.
- G. Conduct all construction operation under this Contract in conformance with the erosion control practices described in Division 1.



### 3.2 CONSTRUCTION METHODS

- A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.
- B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.
- C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas which drain into a drainage system protected by erosion and sediment control measures.
- D. Details for stabilized construction exit are shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.
- E. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.
- F. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.
- G. The length of the stabilized area shall be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than the full width of all points of ingress or egress.
- H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.
- I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.
- J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the City Engineer. These methods include the following:
  - 1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in an application thickness of at least 8 inches.
  - 2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.
  - 3. Steel Mats - Perforated mats placed across perpendicular support members.

**END OF SECTION 01 57 23.11**

## **SECTION 01 57 23.12 – CONTROL OF GROUND WATER**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.
- B. Protecting work against surface runoff and rising floodwaters.
- C. Trapping suspended sediment in the discharge from the surface and ground water control systems.

#### **1.2 MEASUREMENT AND PAYMENT**

##### **A. UNIT PRICES**

- 1. Measurement for control of ground water, if included in Bid Form, will be on either a lump sum basis or a linear foot basis for continuous installations of well points, eductor wells, or deep wells.
- 2. If not included in Bid Form, include the cost to control ground water in unit price for work requiring such controls.
- 3. No separate payment will be made for control of surface water. Include cost to control surface water in unit price for work requiring controls.
- 4. Follow Division 1 for unit price procedures.

- B. Stipulated Price (Lump Sum) Contract. If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600kN-m/m<sup>3</sup>))
- B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)
- C. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

#### **1.4 DEFINITIONS**

- A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.
  - 1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage: includes keeping excavations free of surface and seepage water.
- C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.
- D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.
- B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Division 2 to produce following results:
  1. Effectively reduce hydrostatic pressure affecting:
    - a. Excavations
    - b. Tunnel excavation, face stability or seepage into tunnels
  2. Develop substantially dry and stable subgrade for subsequent construction operations
  3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work
  4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata
  5. Maintain stability of sides and bottom of excavations
- C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.
- D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.
- E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.
- G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.
- H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

- I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

## **1.6 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit Ground Water and Surface Water Control Plan for review by Owner's Representative prior to start of excavation work. Include the following:
  1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control
  2. Names of equipment Suppliers and installation Subcontractors
  3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures
  4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics
  5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations
  6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
  7. Operating requirements, including piezometric control elevations for dewatering and depressurization
  8. Excavation drainage methods including typical drainage layers, sump pump application and other means
  9. Surface water control and drainage installations
  10. Proposed methods and locations for disposing of removed water
- C. Submit following records upon completion of initial installation:
  1. Installation and development reports for well points, eductors, and deep wells
  2. Installation reports and baseline readings for piezometers and monitoring wells
  3. Baseline analytical test data of water from monitoring wells
  4. Initial flow rates
- D. Submit the following records weekly during control of ground and surface water operations:
  1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.
  2. Maintenance records for ground water control installations, piezometers and monitoring wells

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Comply with requirements of agencies having jurisdiction.

- B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.
- D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT AND MATERIALS**

- A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Owner's Representative through submittals required in Paragraph 1.06, Submittals.
- B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate eductors, well points, or deep wells, when needed.
- C. Maintain equipment in good repair and operating condition.
- D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.
- E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.
  - 1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

## **PART 3 EXECUTION**

### **3.1 GROUND WATER CONTROL**

- A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.
- B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.
- C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Owner's Representative in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

- D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.
- E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.
- F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.
- G. Removal of ground water control installations.
  - 1. Remove pumping system components and piping when ground water control is no longer required.
  - 2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor's use, upon completion of testing, as required in accordance with Part 3 of applicable specification.
  - 3. Remove monitoring wells when directed by Owner's Representative.
  - 4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.
- H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hour after placement.
- I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.
- J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.
- K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.
- L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.
- M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

### **3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS**

- A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.
- B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for

monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.

- C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.
- D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.
- E. Replace installations that produce noticeable amounts of sediments after development.
- F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.06B.

### **3.3 SEDIMENT TRAPS**

- A. Install sediment tank as shown on approved plan.
- B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

### **3.4 SEDIMENT SUMP PIT**

- A. Install sediment sump pits as shown on approved plan.
- B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.
- C. Extend standpipe 12 inches to 18 inches above lip of pit.
- D. Convey discharge of water pumped from standpipe to sediment trapping device.
- E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

### **3.5 EXCAVATION DRAINAGE**

- A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

### **3.6 MAINTENANCE AND OBSERVATION**

- A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.
- C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations.

- D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Owner's Representative.

**3.7 MONITORING AND RECORDING**

- A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.
- B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Owner's Representative determines more frequent monitoring and recording are required. Comply with Owner's Representative's direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

**3.8 SURFACE WATER CONTROL**

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.
- B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

**END OF SECTION 01 57 23.12**



## SECTION 01 71 23

### FIELD ENGINEERING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Measures to ensure adequate quality control and quality assurance for all Work in accordance with Conditions of the Contract, as specified herein, and with the quality control and quality assurance requirements of each Specification Section, and authorities having jurisdiction.

##### 1.2 RELATED SECTIONS

- A. All Sections of Work requiring layout, survey, reference points and their verification and protection, and quality control and assurance monitoring requirements.

##### 1.3 DEFINITIONS

- A. Survey and Field Engineering: Wherever the terms “Survey”, “Field Engineering” or any derivative thereof, or similar term appears within this Section, they mean one and the same, and shall mean the survey or field engineering work performed by the Field Engineer as defined below and is separate from that of the survey work provided by the Owner.
- B. Field Engineer: Wherever the term “Field Engineer” or any derivative thereof, or similar term appears in the Contract Documents, it shall refer to the General Contractor’s employee(s) that are expert in, routinely engaged in, and have at least five (5) years experience in, the practice of construction project field engineering, building and project layout, construction measurements and monitoring, etc.
- C. “Construction Surveyor”: Wherever the term “Construction Surveyor”, or any derivative thereof, or similar term appears in the Contract Documents, the entity (person or firm) licensed as a Registered Professional Land Surveyor or Professional Engineer of the discipline required for specific service on the Project in the State in which the Project occurs, with five (5) years minimum experience, and meeting all applicable regulations of the State in which the Project occurs and Department of Labor, and other authorities having jurisdiction to perform the Work. To avoid any misunderstanding or lack of interpretation, the entity responsible for performing the Work of this Section shall be employed by the General Contractor, and the responsibility, including methods and means, is totally that of the General Contractor.
- D. Quality Control and Quality Assurance: Wherever the terms “Quality Control”, “Quality Assurance” or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean an aggregate of activities of the General Contractor, such as design analysis and statistical sampling with inspection for defects, designed to ensure adequate quality in materials and workmanship whether factory manufactured or jobsite produced.

##### 1.4 QUALITY CONTROL AND QUALITY ASSURANCE

- A. Employ a Construction Surveyor complying with the definition above and acceptable to the Owner and Architect, to perform all Construction Surveying. Provide full responsibility for the Construction Surveyor and accuracy of the performance of all items of Work shown on Drawings, specified herein, or in other Specification Sections.

## **SUBMITTALS FOR REVIEW**

- A. Submit name, address, telephone number, fax number, and registration number of the proposed Construction Surveyor prior to starting Work of this Section.
- B. Submit evidence of Construction Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate, if different from Construction Manager's.
- C. Upon request by Architect, submit documentation verifying accuracy of all Survey Work, including a certificate sealed and signed by the Construction Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents and such information has been incorporated into the Project Record Documents.
- D. Submit Project Record Documents under provisions of Section 01 77 00, Closeout Procedures.

## **PART 2 - PRODUCTS**

Not Used

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of discrepancies discovered.

### **3.2 SURVEY REFERENCE POINTS**

- A. Locate and protect survey control and reference points.
- B. Control datum for survey is that established by the Owner provided survey and as indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original Owner's survey control. Make no changes without prior written permission of Architect.

### **3.3 FIELD ENGINEERING AND CONSTRUCTION SURVEYOR REQUIREMENTS**

- A. Establish a minimum of two (2) permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Field Engineer shall establish elevations, lines and levels. Locate, lay out, and monitor by instrumentation and similar appropriate means Work, including, but not be limited to:
  - 1. elevations, and layout of property lines and easements;
  - 2. site drainage, including storm water control and pollution prevention measures, slopes, swales, and invert elevations;
  - 3. limits of clearing and grubbing, including identification of trees and planting to be removed and methods for protection of those to remain;

4. excavations, fill and topsoil placement, and all (rough and finish) grades;
  5. trenching and trench safety;
  6. utility locations;
  7. concrete and asphaltic concrete paving, curbs, ramps, and other site improvements, as applicable;
  8. grid or axis for structures, batter board locations;
  9. elevation, grade controls, and layout of building foundation and grade beams, column locations, base plates, embedded items, depressions, formwork, and openings in concrete, including all interior finish grades;
  10. elevations of structural steel, including, steel joists/trusses, steel decks, and associated miscellaneous metals;
  11. elevations and layout of masonry, including concrete masonry units (CMU), face brick, cast stone, and other elements built-in masonry.
  12. elevations and slopes of roofing, including those for lightweight insulating concrete deck system, if applicable.
  13. elevations and layout of work as required to ensure proper operation, clearances, and tolerances, including conveying systems, plumbing and mechanical work; and
  14. monitoring of movement and protection of existing or adjacent structures, as applicable.
- C. Throughout course of Work, verify existing conditions and layouts by same means as originally used to ensure conformance with design requirements and details. Notify Architect immediately, if discrepancies are found.
- D. Provide one (1) copy each of reduced Field Engineer's notes to the Architect, Owner, Construction Surveyor, and affected Consultant within four (4) working days of completion of each portion of the Field Engineering Work.
- E. Field Engineer's notes shall be clear and complete. The Field Engineer shall be available at no expense to the Owner, Architect, or Consultants for note interpretation, if required.
- F. Field Engineer shall perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- G. Provide Construction Surveying services. Utilize recognized engineering survey practices.
- H. Construction Surveyor shall verify and record/document their findings, on a drawn survey at a scale matching that of the original Contract Documents, for the following:
1. All property lines and corners
  2. All building corners
  3. All paving corners
  4. Finish floor of all/each buildings
  5. Invert elevations, flow lines for all site drainage structures and improvements
- I. Payment for earthwork quantities shall be for materials in place, compacted, and determined by neat line method.
- J. Provide the Owner a reproducible hard copy and digital/electronic file copy of all the Construction Surveyor's work.

**3.4 PROJECT RECORD DOCUMENTS**

- A. Maintain a complete and accurate log of control and Field Engineer work as it progresses.
- B. Upon completion of Work, including, but not limited to earthwork, formwork, foundation, structural steel erection, and major site improvements, prepare Project Record Documents illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Project Record Documents as specified in Paragraph 1.5.

**END OF SECTION**

## SECTION 01 71 50

### PREVENTIVE HOUSEKEEPING AND FINAL CARPET CLEANING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

#### PART 1 – GENERAL

##### 1.1 SCOPE OF WORK

- A. Cleaning of new and existing Tandus Powerbond carpet within the Project work area at the end of each work window upon substantial completion of work scheduled each day. Work window shall be determined by and coordinated with Owner.
- B. Clean entire area of building where construction or scope of work occurs, and all areas affected by construction activities including but not limited to dirt, debris and construction dust.
- C. Preventive Daily Housekeeping. The following are intended as a guide to facilitate the daily maintenance and cleanliness of the construction site, including but not limited to:
  - 1. Renovations involving the commons cafeteria where the stage curtain may be exposed/soiled by construction materials, dirt, dust etc. the curtain shall be removed prior to construction and stored according to curtain Manufacturer's recommended procedures and methods. Contractor reinstall after final cleaning. Contractor is responsible for curtain cleaning should it become soiled from construction activities per Curtain Manufacturer's methods.
  - 2. Contractor to segregate phased and/or areas of construction from all other areas of the building with a sealed, airtight construction barrier.
  - 3. Contractor shall provide additional AHU air filtration to protect existing Owner HVAC systems and other areas of building from becoming soiled from construction activities and dust. Should construction dirt and dust accumulate in affected construction areas, Contractor shall provide final cleaning of those spaces.
  - 4. Contractor is to prevent daily accumulation of construction dust or any other material that can cause any safety hazard.
  - 5. Contractor to eliminate, as practical as possible, tracking of dirt and debris prior to entering building each time.
  - 6. In an effort to protect existing flooring surfaces, Contractor is responsible for providing adhesive plastic sheeting and Masonite and/or plywood to prevent accumulation of all contaminants, including but not limited to: dirt, damaging foot traffic, lift equipment, machinery oil, etc. Continuously inspect and provide replacement/maintenance as needed of sheeting and Masonite/plywood as appropriate to construction intensity.
  - 7. Daily cleaning and maintenance of existing carpet to utilize procedure itemized in subsection 3.1 prior to cold water extraction.

#### PART 2 – PRODUCTS

##### 2.1 CERTIFIED MAINTENANCE PARTNERS

- A. Corporate Care  
Phone: 713-692-6300  
Attn: Sean Barnett
- B. GCA Services Group  
Phone: 972-276-5858  
Attn: Dub Spencer

- C. Texan Floor Service  
Phone: 713-956-9966  
Attn: Jeff Hill

## 2.2 MATERIALS

- A. Cleaning Solutions: Cleaning solutions shall be used according to manufacturer's instructions. Review the material safety data sheets (MSDS) and/or safety data sheet (SDS), and product labels on solutions, being aware of any precautions and usage guidelines.
  - 1. Below are the minimum requirements for cleaning solutions to be used on C&A carpet. Contact your supplier to assure that these guidelines are met:
    - a. Shall be safe and non-toxic.
    - b. Shall contain no optical brighteners.
    - c. Shall have a pH between 5 and 9 diluted for normal cleaning.
    - d. Do not leave a sticky or oily residue when dried.
    - e. Will not damage carpet's fiber or color.
    - f. Will not promote rapid soiling.
  - 2. Conduct the following test to evaluate the type of residue a solution leaves behind:
    - a. Prepare the solution and pour in a pan.
    - b. Place in direct sunlight and allow to evaporate. If it leaves a sticky or oily residue, do not use. The carpet manufacturer can provide approved cleaning agents and deodorizers for the specific carpet. These cleaners have been tested for appropriate pH levels, absence of optical brighteners and zero resoil potential.

## 2.3 EQUIPMENT

- A. Equipment: Use the effective, well-functioning equipment:
  - 1. Vacuum Cleaner: Use a commercial vacuum cleaner that exceeds the established industry standards for soil removal. For improved indoor air quality, the vacuum shall have high efficiency filtration and shall emit minimal particles into the air. (The carpet manufacturer can provide a list of suggested vacuum cleaners.)
  - 2. Pile Lifter: Use a pile lifter to assist in the cleaning process to aggressively lift the pile fiber and loosen attached soil prior to vacuuming. Because of this aggressiveness, caution must be used when cleaning C&A's Syntex® products. (The carpet manufacturer can provide a list of suggested pile lifters.)
  - 3. Extractors: Provide hot water extraction for final deep cleaning and maintenance.
    - a. Selection should be based upon the needs of the facility. In general, the following minimum performance should be considered:
      - 1) Extractor should be C&A approved and capable of extracting a maximum volume of water injected into carpet pile fiber.
      - 2) Components should be made of a material that is non-corrosive and will not rust or deteriorate in the presence of water and/or cleaning solutions.
      - 3) Extractor should be able to generate a minimum of 50 pounds per square inch (psi) of pressure and should not exceed 400 psi.
      - 4) The carpet manufacturer can provide a list of suggested extractors.
  - 4. Portable Air Mover:
    - a. Carpet can dry within 2 to 3 hours in most environments. Drying time should never exceed 12 hours.
    - b. When extreme environmental conditions exist (relative humidity exceeds 65%), an air mover or drying fan should be used to accelerate drying time.
    - c. The carpet manufacturer can provide a list of suggested portable air movers

## PART 3 – EXECUTION

### 3.1 PROCEDURE

- A. Cleaning Procedures:
1. Vacuuming
    - a. Make sure the vacuum cleaner is in proper working order before each use. (Clean all components regularly.)
    - b. Use slow, overlapping passes. Slowing the vacuum down allows the suction to loosen and remove the embedded dry soil that can abrade and damage fibers.
    - c. Pay careful attention to the “pull” stroke. More soil is removed in this action than in the forward stroke.
    - d. Empty vacuum bags when they become half full to improve soil removal.
    - e. Replace nylon brushes at the first sign of wear.
    - f. Use only original equipment manufacturer parts for consistent performance.
  2. Spill Removal
    - a. Spills may require cleaning solutions to remove.
    - b. The spill/liquid should be blotted into paper or cloth towels.
    - c. Place several layers of towels over the spill and apply pressure until all of the excess liquid has been removed.
    - d. Use a portable spot removal extractor with cold water solution.
  3. Spot Removal
    - a. Determine if the spot is a water-soluble or oil-based stain by applying clean water and blot with absorbent towel. Water-soluble spots will transfer to the towel; oil-based spots will not. Clean spot using one of the following methods:
      - 1) For water-based spots: Continue rinsing with water as long as there is transfer to the towel. A cleaning agent may not be necessary if water continues to remove the spot. If a cleaning agent is needed, apply a Manufacturer approved (Collins and Aikman for TanduS carpets) spot lifter to the area and allow to soak for 5 minutes. Then, flush thoroughly with water until all detergent residue has been removed. Repeat this process until the spot is removed.
      - 2) For oil-based spots: After blotting to remove excess liquid, apply a non-water based dry-cleaning solvent\* to a towel and apply to the spot. (Applying a dry-cleaning solvent directly to the Carpet surface may allow the spot to spread.) Work from the outer edges of the spot to limit spreading. Continue to reapply solution in this manner until the spot is completely removed. Then flush thoroughly with water until all residue has been removed. In case of permanent stains, repairs may be necessary.\*Dry-cleaning solvents denote isopropyl alcohol, denatured alcohol and other, non-water-based cleaning solutions.
  4. Extraction
    - a. In addition to vacuuming and spot removal, extraction will help maintain Carpet’s appearance.
    - b. The procedure for effective soil removal is as follows:
      - 1) Pile lift all heavy soiling areas.
      - 2) Thoroughly vacuum the entire area to remove dry soil.
      - 3) Never use detergent in the extractor rinse tank.
      - 4) Pre-spray the area with an approved pre-spray solution.
      - 5) Use agitation for improved cleaning results.
      - 6) Allow the solution to remain undisturbed for 5 to 10 minutes. This will make the soil easier to remove.
      - 7) Extract the area thoroughly to rinse and remove all the detergent and soil.
      - 8) Repeat until recovery water is relatively clean.
      - 9) Place air movers on the area to expedite the drying time.
      - 10) Limit foot traffic on the area until dry.
    - c. Extraction equipment guidelines:

- 1) Make sure extractor is in proper working order.
  - 2) Disinfect freshwater tank and recovery tank on a weekly basis.
  - 3) Replace nylon brushes at the first sign of wear.
  - 4) Use only original equipment manufacturer parts for consistent performance.
5. Tape Residue Removal
- 1) Following removal of carpet and flooring protective measures, including but not limited to plastic sheeting, adhesive plastic sheeting, Masonite, tape, etc., Contractor is responsible for complete removal of tape residue (per flooring manufacturer recommendations) from flooring surfaces prior to final cleaning.

### 3.2 SCHEDULE

- A. Traffic Patterns: Identify and evaluate the traffic patterns in the facility and get approval from Owner. Using a floor plan of the facility, color code the plan to identify each of the areas.
- B. Cleaning Schedule:
1. Track-Off Areas: Areas where outside soil is tracked in (entrances, lobbies, restrooms, elevators, and areas next to hard-surface flooring). These areas require specific attention.
    - a. Pre-vacuum prior to spot cleaning
    - b. Spot clean to remove entrenched stains
    - c. Vacuum again using multiple passes
    - d. Pile lift to loosen embedded soil prior to extraction
    - e. Wet extract in each direction using multiple passes to achieve desired appearance level
    - f. Spot clean as necessary
    - g. Vacuum
  2. Heavy Traffic Zones: Areas that experience more than 1,000 foot traffics per day (staging areas, traffic lanes, pivot points and funnel areas)
    - a. Vacuum using multiple passes
    - b. Pile lift to loosen embedded soil prior to extraction
    - c. Wet extract to achieve desired appearance level
    - d. Spot clean as necessary
    - e. Vacuum
  3. Moderate Traffic Zones: Areas that experience 500 to 1,000 foot traffics per day (secondary hallways, administrative areas, offices, and light-use common areas)
    - a. Vacuum using multiple passes
    - b. Pile lift to loosen embedded soil prior to extraction
    - c. Wet extract to achieve desired appearance level
    - d. Spot clean as necessary
    - e. Vacuum
  4. Light Traffic Zones: Areas that experience less than 500-foot traffics per day (conference rooms, areas outside of traffic lanes, and limited use-area)
    - a. Vacuum using multiple passes
    - b. Wet extract as necessary to achieve desired appearance level
    - c. Spot clean as necessary
    - d. Vacuum



5. Areas Prone to Spots and Stains: (break rooms, coffee areas and areas near kitchens)
  - a. Pre-vacuum prior to spot cleaning
  - b. Spot clean to remove undesirable stains
  - c. Pile lift and wet extract as required according to traffic zone identification above
  - d. Spot clean again as necessary
  - e. Vacuum

**END OF SECTION**

## SECTION 01 77 00

### GUARANTEES, CERTIFICATES AND CLOSE-OUT

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION I APPLY TO THIS SECTION.

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Certain procedures have been developed and are required to fulfill all provisions of the Owner-Contractor Agreement with respect to contract Final Completion and Contract Close-Out for the work/project to be 100% complete.
- B. Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended and Section CB – Supplementary Conditions of the Contract for Construction; as amended for additional information and requirements.

#### PART 2 - SUBSTANTIAL COMPLETION

##### 2.1 GENERAL

- A. Projects that involve phase sequential construction of major definable areas of projects that involve separate work on multiple campuses shall have Certificates of Substantial Completion issued for each phase or campus, as applicable and agreed upon by the Owner and Contractor. All conditions for Substantial Completion, including liquidated damages, shall apply for each date of Substantial Completion for each phase or campus, as applicable.
- B. Individual Substantial Completion Dates for each phase or campus shall be determined and agreed upon by the Owner, Architect and Contractor. Where an Alternative Proposal dictating a required, guaranteed completion date (dates) is included in the Proposal Form and accepted by the Owner, the date(s) stated therein shall establish the Substantial Completion Dates to be incorporated into the Agreement.
- C. The following items are a partial list of requirements, as applicable to the Project, which must be completed prior to establishment of a Substantial Completion date. Refer to substantial completion checklist contained within the AIA Document A201™-2017, General Conditions of the Contract for Construction as amended for a complete list.
  - 1. All fire alarm system components must be completed and demonstrated to the Owner.
  - 2. All inspections by government authorities having jurisdiction over the project must have been finalized, any remedial work required by them must have been completed, and Certificates of Occupancy, local fire marshal and health department approval certificates and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
  - 3. All exterior clean-up and landscaping must be complete, including required stand of grass mowed, edged, weeded, and fertilized.
  - 4. All interior shall have been completed and cleaned except minor items which, if complete after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. Contractor shall provide list of these specific items, which include punch list and completion items. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect shall be the sole judge of what constitutes a significantly large number of items.
  - 5. All third-party HVAC air and water balancing must be complete.

6. All energy management systems must be complete, fully operational and demonstrated to the Owner, with graphics transferred to the main server.
  7. All emergency/standby generator and low voltage lighting control systems must be complete, fully operational and demonstrated to the Owner.
  8. All security systems must be complete, fully operational and demonstrated to the Owner, and must be monitorable from the District's central Police/Security Center.
  9. All school communications equipment, telephone systems and P.A. systems must be complete and demonstrated to the Owner.
  10. All final lockset cores must be installed and all final Owner directed keying completed.
  11. All room plaques and exterior signage must be complete.
  12. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment and all life safety systems.
  13. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
  14. All operation and maintenance manuals are delivered and approved by Architect and Owner ("D-slant" ring binders in duplicate).
  15. Health Department Inspections and Municipal Utility District (MUD) and Drainage District and County approvals must be provided.
  16. All other reports, testing results, certifications, studies, etc. required by Contract Documents.
- D. Final Cleaning:
1. The work area shall be thoroughly cleaned inside and outside. Cleaning includes removal of smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces. Refer to Section 01 71 50 for final clean requirements of remodel areas and carpet.
  2. Remove all temporary facilities.
- E. In order for the project, a major portion thereof, a project phase or project campus to be considered Substantially Complete, the following conditions must be met:
1. All inspections by governmental authorities having jurisdiction over the project must have been finalized; any remedial work required by them must have been completed; and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
  2. All work, interior and exterior, shall have been completed and cleaned except minor items (Punch List) which, if completed after occupancy, will not, in the Owner's opinion, cause any interference to the Owner's use of the building or any portion thereof.
  3. All items stipulated in 2.1-C above.
- F. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner, at his sole discretion, may make (partial) payment of retainage applying to such work or designated portion thereof which is 100% complete and accepted by the Owner. Such payment, if made at all, shall be adjusted in the Owner's favor for work that is incomplete or not in accordance with the requirements of the Contract Documents.
- G. The date of Substantial Completion shall represent day one (1) of the thirty (30) day period to complete all work and correct all deficiencies contained in the Punch List and the ninety (90) day period allowed for complete Contract Close-Out as described below.

## 2.2 PUNCH LIST

- A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of work to be completed, if any. This list is intended to represent a limited number of items needing attention.

- B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
  - 1. Room number or other suitable location identifier
  - 2. Description of the work
  - 3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
  - 4. Sub-contractor/ trade sign-off date
  - 5. General contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
  - 6. General contractor/ trade sign-off date
  - 7. A/E consultant sign-off
  - 8. A/E consultant sign-off date
  - 9. If requested by the Owner, provide two additional similar columns for their sign-off
  - 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the contractor/sub-contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.
  
- C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for re- inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.
  
- D. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion.
  
- E. The Contractor's superintendent shall participate in the preparation of the Contractor's punch list that is submitted to the Architect and Owner for supplementation. Upon receipt, the Architect and Consultants shall perform a spot review to determine the adequacy and completeness of the Contractor's punch list.
  
- F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany the Architect, his Consultants, and the Owner (at his discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
  - 1. The Superintendent shall record or otherwise take note of all supplementary items.
  - 2. The Architect will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the Contractor's receiving said supplements from the Architect will not be cause for a claim for additional cost or extension of time as the Contractor's Superintendent shall have been in attendance during the inspections of the Architect and his Consultants and will have been expected to take his own notes.

### **2.3 OPERATIONS AND MAINTENANCE MANUALS**

- A. Operation and Maintenance (O&M) Manuals shall be delivered prior to, and are a condition of, Substantial Completion to allow the Owner the benefit of having the manuals for on-site training and start-up procedures provided by the Contractor.
  
- B. Operation and Maintenance (O&M) Manuals shall provide concise descriptions, technical information, principles of operation; operating instructions, maintenance instructions and schedules, MSDS sheets, and other information that will enable the proper on-going operation and maintenance of the material and/or assembly.

- C. Separate O&M Manuals shall be provided for the following as applicable to the project scope of work:
  - 1. Architectural materials, equipment and/or assemblies
  - 2. Food services materials, equipment and/or assemblies
  - 3. Mechanical materials, equipment and/or assemblies
  - 4. Plumbing materials, equipment and/or assemblies
  - 5. Electrical materials, equipment and/or assemblies
  - 6. Low-voltage systems materials, equipment and/or assemblies
  - 7. Theater lighting/sound systems materials, equipment and/or assemblies
- D. Provide O&M Manuals/information for all materials, equipment and/or assemblies where required in individual sections of specifications.
- E. Each O&M Manual shall contain a cover and spine label depicting contents as delineated in paragraph C above; and within each Manual shall be organized in numerical order corresponding to specification sections.
- F. O&M Manuals shall be provided in 3-ring binders similar to close-out manuals described above.
  - 1. O&M manuals shall contain a table of contents listing the specification number with corresponding general description of the material, equipment, and/or assembly included in the manual.
  - 2. The indexed sections shall be divided and identified by tabbing each section as listed in the index.
- G. Deliverables:
  - 1. Provide electronic copy of all O&M manuals for review. Deliver A/E Consultant O&M Manuals directly to the relative A/E Consultant with a copy of the transmittal to the Architect.
  - 2. Resubmit as necessary to obtain final acceptance of Manuals.
  - 3. Once all corrections have been made and the O&M Manuals found to be acceptable, provide one (1) hard copy of each binder and one (1) PDF format electronic copy of each binder to the Architect for transfer to the Owner.

## 2.4 SUBSTANTIAL COMPLETION SCHEDULE

- A. After the date of Substantial Completion of the project as evidenced by the Certificate of Substantial Completion, AIA document G704-2000, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to complete all work and correct all deficiencies contained in the Punch List attached to the Certificate of Substantial Completion. It is incumbent upon the Contractor to request Substantial Completion **only** when there is assurance that all work included on the Punch List shall be completed within the thirty (30) day time frame.
  - 1. In the event the Owner must take occupancy of the project prior to Contractor's completion of the punch list, the Contractor shall make all adjustments necessary to schedule the work to allow full and normal operation of the project by the Owner.
  - 2. Where this requires work outside of normal business hours, the work shall be provided at no additional cost to the Owner.
- B. Upon Contractor's and sub-contractor's verification that all punch list items have been 100% completed, the Contractor shall notify the Architect and the Architect and consultant(s) shall conduct an on-site observation to verify that all items are 100% complete.
  - 1. On-site verifications for partial completions, if any, shall be conducted by the Architect at the Architect's discretion.

2. If any items shown to be complete by the Contractor are found not to be complete by the Architect, the observation shall be stopped, with such notification to the Contractor.
  3. Contractor's requested punch list observations by the Architect shall be limited to a maximum of two (2) per punch list.
- C. If the Contractor fails to complete all work on the punch list within thirty (30) days after the Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the punch list items are completed and accepted by the Owner. During this time the Contractor will be charged from the Owner's, Architect's and any A/E Consultant's time associated with achieving completion of the punch list.
1. Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
  2. The weekly meetings shall include a minimum of two (2) hours charge per participant.
- D. Owner billable time shall be deducted from the Contractor's Final Payment or separately invoiced to the Contractor at Owner's option. Owner billable hourly rates shall be as follows:
1. Assistant Superintendent: \$200.00 per hour
  2. Director: \$175.00 per hour
  3. Project Manager: \$150.00 per hour
  4. Project Coordinator: \$120.00 per hour
  5. Administration/Secretarial: \$50.00 per hour
- E. Architect and A/E Consultant billable time shall be invoiced to the Contractor by the Architect. A/E billable rates shall be as follows:
1. A/E Principal: \$175.00 per hour
  2. A/E Project Manager: \$150.00 per hour
  3. Staff Architect/Consultant: \$120.00 per hour
  4. A/E Field Representative: \$100.00 per hour
  5. Administration/Secretarial: \$50.00 per hour

### **PART 3- PRODUCTS**

- 3.1 Not used.

### **PART 4 - CONTRACT CLOSE-OUT**

#### **4.1 GENERAL**

- A. Upon issuance of the (final) Certificate of Substantial Completion, and per the Owner- Contractor Agreement, the Contractor will be allowed a period of ninety (90) days within which to complete all Contract Close-Out requirements, unless extended by mutual agreement or provision of the Contract.
- B. In addition to all work and requirements described for Substantial Completion, in order to achieve Contract Close-Out, the Contractor shall submit all Close-Out documents per Form AO.

#### **Record Document**

- C. Final/ 100% release of retainage will not be authorized by the Architect until the Contractor completes all of the requirements for Contract Close-out; and until all expenses incurred and to be paid by the Contractor have been paid in full.

- D. It is the Contractor's sole responsibility prior to submission to verify that Close-Out documents being submitted for review and acceptance are 100% complete and accurate. The Owner/Architect reserves the right to reject any incomplete close-out documents.
1. Upon discovery by the Architect that Close-Out documents are incomplete and/or inaccurate, the Architect's review shall cease, and the Contractor shall be so notified.
  2. The A/E Consultants' will provide a comprehensive list of possible missing and/or incorrect items needed.
- E. It is desirable and beneficial to submit all Close-Out documents as a single submission; however, Close-Out documents may be submitted separately in four (4) deliverables as follows:
1. Close-Out Documents Manual
  2. Operations and Maintenance Manuals (required prior to Substantial Completion)
  3. Record Drawings
  4. Owner's Record Copy of Submittals (one (1) flash drive in PDF format)
- F. Close Out Tracking
1. Contractor shall track the progress of project closeout utilizing excel spreadsheets which will be provided by the Architect (see examples attached at the end of this Spec Section).
  2. Contractor shall update closeout tracking spreadsheets weekly and submit electronic copy to Architect twenty-four hours prior to the weekly closeout review meetings.
  3. Master Closeout Checklist represents all items required to be provided by the Contractor to the Owner at the conclusion of the project. It is more general in nature and only includes a status of the closeout item in question. It does not drill down into the details of when the item was submitted, why it was rejected, when it was approved, etc. This checklist will be used throughout the project to track all closeout deliverables.
  4. Detailed Checklists are more comprehensive lists developed for each section of the closeout requirements. These lists are used by the Contractor to identify and track every deliverable required from each subcontractor. This list will contain a separate entry for each item that is required from each and every subcontractor. It should include the specification section that lists the requirement, a description of the item, responsible subcontractor, and the dates that the items were requested, received, and transmitted to the Owner. The information included in these detailed checklists is used to update the Master Closeout Checklist.
  5. A sample of the Master and Detailed Checklists are attached at the end of this Spec Section. An excel file with the checklists will be provided by Architect.

#### 4.2 CLOSE-OUT MANUALS FORMAT

- A. All close-out documents shall be submitted in CFISD provided digital format with detailed table of contents, intext tabs corresponding to the table of contents.
1. The close-out documents must be neatly organized and easily useable, as determined by the Architect and Owner.
  2. At completion and final review, submit one (1) electronic PDF file and one (1) flash drive containing close-outs.

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### Part 1: Close-Out Log

- a. Project Checklist – Form AO
- b. Close Out Log

### Part 2: Project Directory

- a. Project Team (architect, engineer, contractor, consultants)
- b. List of Final Subcontractors/Suppliers/Local Representatives (by Specification Section)

### Part 3: Close-out Documents and Affidavits

- a. AIA G707 - Consent of Surety to Final Payment
- b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims
- c. AIA G706A - Contractor's Affidavit of Release of Liens
- d. Subcontractor's Release of Lien

### Part 4: Project Documents and Certificates

- a. AIA G704 - Certificate of Substantial Completion
- b. Punch List / Architects Letter Confirming Completed Punch List
- c. Copy of All Permits
- d. Copy of Final Utility Bill or Letter of Transfer
- e. Certificate of Occupancy
- f. Certification of Project Compliance
- g. Hazardous Material Certificate
- h. Asbestos Manifest / TDLR Inspection / EAB Letter / Structural Letter / Material Testing Letter(s) / Commissioning / other Consultants
- i. Form AQ - Certificate of Final Completion

### Part 5: Warranties (Compiled Sequentially by Specification)

- a. General Contractor's Warranty
- b. Subcontractor's Warranty
- c. Extended Warranties & Maintenance / Service Agreements

### Part 6: Insurance (General Contractor / Subcontractor)

- a. Continued Coverage
- b. Worker's Compensation Certificate

### Part 7: Receipts

- a. Extra Stock by Division
- b. Keys
- c. Paint Mix Cards

### Part 8: Record Documents

- a. Demonstration and Training Sign-in Sheets by Division with Digital Video
- b. Operations & Maintenance Manuals and Record Drawing Transmittal(s)

## 4.3 WARRANTIES

- A. All guarantees and warranties required by the Contract Documents shall establish the date of Substantial Completion as day one (1) of the required warranty period; regardless of how long the product, assembly or work has been installed or in operation prior to Substantial Completion.



1. Coordinate with subcontractors and material suppliers to account for provision in their original proposal/bid amount, if necessary.
- B. Contractor's One-Year Warranty: The Contract requires the General Contractor to warrant ALL materials and work provided/furnished for a period of one (1) year following the date of Substantial Completion.
  1. The one-year general warranty shall include all labor, material and delivery costs required to correct defective material or installation during the Warranty period.
- C. Sub-Contractor's One-Year Warranty: each sub-contractor that performed work on the project shall be required to submit a one-year warranty similar to the above Contractor's One-Year Warranty for their specific work provided.
- D. Extended Warranties: In addition to the General Contractors and subcontractors' one-year warranty, other required guarantees shall be included in the Close-Out Binder in original issue form. All extended warranties shall begin on the Substantial Completion date; and shall include all labor, material and delivery costs required to correct defective material or installation for the entire required extended warranty period, as specified in the respective specification section.

#### 4.4 RECORD DRAWINGS:

- A. Upon Substantial Completion, the Contractor shall be furnished, at no charge, a complete set of electronic files in AutoCAD release 2018 or later, and Revit if applicable, of all drawings included in the Contract Documents. The title blocks shall be stripped of all logos, disclaimers and licensed seals of the Architect and Consultants.
  1. Throughout the construction phase, Architect's and Consultant's supplemental drawings/sketches provided to the Contractor in AutoCAD and Revit format shall be provided to the Contractor electronically and shall be incorporated in the electronic files by the Contractor.
- B. Upon request, the Architect and/or Consultants shall assist the Contractor with understanding the structure and composition of the electronic files to facilitate the generation of the Record Drawings.
- C. The Contractor shall modify the title block on each/every sheet to include only the project name, project address, Owner name, consultants' name and address, date, and clearly identify the set as "Record Drawings".
- D. All record drawings shall be provided in AutoCAD, Revit, and PDF formats. AutoCAD files shall be provided in "E-Transmit" format with all associated external references, image files, plot styles, and blocks included. CAD files shall be provided and labeled by sheet number. External references shall be setup up with relative file paths and not full (absolute) file paths. PDF files that are provided shall be one complete pdf file with the complete set of drawing files. The PDF shall be bookmarked by sheet number. Specifications shall be submitted in the same manner where they are complete pdf files by volume and bookmarked by specification section. In addition to the complete drawing set PDF, a separate file folder shall be provided with each sheet in the set saved as a separate file with the file named by sheet number. Create sub folders by discipline for all the individual sheet files.
- E. All modifications, additions, deletions, and revisions made to the project during the construction phase shall be reflected on the Record Drawings; and shall include, but not necessarily limited to:
  1. All as-built dimensions (different than original dimensions)
  2. All as-built locations and conditions relative to underground plumbing, sanitary and storm piping installations, natural gas piping and electrical conduits; shown accurately to within twelve (12) inches. Notes shall indicate approximate depth of all underground piping and utilities.
  3. All as-built conditions relative to ductwork installations; shown accurately to within six (6) inches.

4. All as-built conditions relative to HVAC water piping installations; shown accurately to within six (6) inches.
  5. All as-built conditions relative to underground electrical conduit installations. shown accurately to within six (6) inches.
  6. Record drawings shall include a copy of fire sprinkler layout of piping and equipment.
  7. All approved CPR's resulting in a physical change in the work.
  8. All RFI's resulting in a physical change in the work.
  9. All AEA's resulting in a physical change in the work.
  10. All Minor Changes resulting in a physical change in the work.
  11. All Construction Change Directives resulting in a physical change in the work.
  12. Update the list of drawings as necessary to reflect added and deleted sheets.
- F. All modifications shall be represented by actually deleting the original work and accurately depicting the revised as-built modifications/configurations. "X-ing out" deleted work shall not be accepted.
- G. Upon completion of all revisions to the Record Drawings, including the Architect's acceptance, the Record Drawings shall be copied to a thumb drive or solid-state media drive maintaining the exact folder/file structure originally furnished to the Contractor. Submit to the Architect for review before proceeding with deliverables.
- H. Deliverables: Upon Deliverables: review and acceptance of the documentation, including format, the Architect shall direct the Contractor to proceed with delivery of the following:
1. Three (3) thumb drives or solid-state media drives, containing the entire set of Record Drawings in PDF and TIFF format. Each sheet shall be a separate PDF and TIFF file. The thumb drives shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with record drawing modifications.

#### **4.5 RECORD SUBMITTALS**

- A. The Contractor shall maintain and submit a separate set of final submittals to be delivered to the Owner as a condition of Contract Close-Out.
- B. Include only the final version of each submittal, including all submittal review comment sheets from the Architect and Consultant. Versions of submittals that were rejected or required to be revised and resubmitted are not required.
- C. Deliverables:
1. Deliver one (1) hard copy set of Record Submittals in file boxes, organized in order by specification division, with tabs included for each section of specifications and submittal log of contents of each file box.
  2. Deliver three (3) copies of all Record Submittals in PDF electronic format on three (3) thumb drives or solid-state media drives.

#### **4.6 RECORD SPECIFICATIONS/PROJECT MANUAL**

- A. The Contractor shall submit a record copy of specifications in PDF format on thumb drive or solid-state media drive. The PDF shall be formatted as stated in section 4.4, subsection D of this specification document. Record specifications shall be edited to contain only actual manufacturers, products, colors and model numbers actually used in the project.

#### **4.7 CONTRACT CLOSE-OUT SCHEDULE**

- A. If the Contractor fails to complete requirements of Contract Close-Out within sixty (60) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the Close-Out documents are

- completed and accepted by the Owner. During this time the Contractor will be charged for the Owner's, Architect's and any A/E Consultant's time associated with achieving Final Completion.
1. Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
  2. The weekly meetings shall include a minimum of two (2) hours charge per participant.
  3. Refer to A201 – for Owner and Architect/A&E/Consultants billable times.
- B. In scheduling submission(s) and final approvals of Close-Out documents, the Contractor shall allow for the following review period for each submission:
1. Architect: Ten (10) calendar days
  2. Architect's Consultant: Twelve (12) calendar days.
- C. Additionally, failure by the Contractor to complete Contract Close-Out within the stipulated time will be reported to the Contractor's surety. In the report of deficiency, the Contractor and surety will be informed that, should correction work remain incomplete for fifteen (15) additional days, the Owner at his discretion may initiate action to complete corrective work out of the remaining contract funds in accordance with the Owner-Contractor Agreement, General and Supplementary Conditions to the Agreement as they apply.
1. Additional costs of the Owner, Architect, and other consultants incurred because of the Contractor's failure to complete Contract Close-Out within sixty (60) days after the date of Substantial Completion, unless extended by mutual agreement or provision of the contract, will be deducted from the funds remaining to be paid to the Contractor.

#### 4.8 WARRANTY INSPECTION

**Refer to:** This summary is in accordance with AIA Document A201 § 3.5 - Warranty.

- A. Warranty periods start from Substantial Completion. If repairs are done post-Substantial Completion, warranty periods extend accordingly. The Contractor must track all warranty work and ensure its completion.
- B. Scheduled Inspections:
1. Approximately six months after Substantial Completion, and one month before the expiration of the one-year warranty, the Contractor shall notify the Architect and Owner to schedule a warranty inspection. A minimum of 10 days' notice must be provided to both the Architect and Owner prior to the inspection.
  2. At the scheduled inspections (6 and 11 months after Substantial Completion), the Contractor will inspect the project with the Owner and Architect and correct any deficiencies.
- C. Corrective Action:
1. For any defective work identified, the Contractor must immediately provide the necessary materials and labor to remedy the issues and continue working until the corrections are completed to the satisfaction of the Architect and Owner, even if the corrective work extends beyond the expiration of the warranty period.
  2. The Contractor is not responsible for correcting work that has been damaged by Owner neglect or abuse, or for replacing parts due to normal wear and tear.
- D. Warranty work must be completed within 10 working days unless specified otherwise. For urgent issues (e.g., life safety, HVAC, security), response times range from 4 to 6 hours.

- E. For urgent warranty requests, the Contractor must maintain an answering service available 24/7, 365 days a year.
- F. If the Contractor fails to complete warranty work within the specified timeframe, the Owner can complete the work and backcharge the Contractor for all related costs.

**END OF SECTION**

## SECTION 01 91 00

### GENERAL COMMISSIONING REQUIREMENTS

#### PART 1 – GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Specifications throughout all Divisions of the Project Manual, which pertain to operable and non-operable equipment and/or building systems, are directly applicable to this Section, and this Section is directly applicable to them.

##### 1.2 SUMMARY

- A. This Section establishes general and administrative requirements pertaining to commissioning of equipment, devices, and building systems on the project. Technical requirements for commissioning of particular systems and components are established in the respective technical sections of this Project Manual.
- B. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents, the Owner's Project Requirements (OPR) and the Basis of Design (BOD). During Commissioning, the Contractor systematically demonstrates to the Owner or Owner's representative that the operable systems have been installed and performing in strict accordance with the Contract Documents.
- C. Commissioning requires cooperation and involvement of all parties throughout the construction process. The Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion with the exception of Deferred tests approved in advance by the Owner.
- D. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, System Verification Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, Integrated System Tests, Contractor demonstration to the Owner, and training of Owner's personnel. This requires assembling all related documentation into one cohesive collection. Commissioning is intended to achieve the following specific objectives of the Contract Documents:
- E. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.
- F. Ensure that operating and maintenance and Commissioning documentation requirements are complete.
- G. Provide the Owner with functional buildings and systems that meet the Contract Document requirements and the Owner's Project Requirements (OPR) at Substantial Completion.

##### 1.3 DEFINITIONS

- A. Basis of Design (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning (Cx): A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Project Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and the Contractor has provided the Owner adequate system documentation and training.

- C. Commissioning Authority (CxA): Party having a contractual agreement with the Owner to provide third party commissioning services as defined herein under Commissioning Authority's Role and Responsibilities. Commissioning Authority may represent the Owner and is authorized to act on behalf of the Owner. The Commissioning Authority does not have authority to alter design or installation procedures without the written approval of the Owner or the design team.
- D. Contract Documents: The General Conditions, Drawings, Specifications, Addenda, and other documents developed by the A/E Team and approved by the Owner that constitute the contractual obligations of the project scope.
- E. Control Point and Sensor Calibration Verification: Process of verifying the point integrity and/or sensor calibration from the physical point of monitoring (sensor, contact, actuator, etc.) to the digital point location at the Operator's interface within the respective control system (Building Automation, Lighting Controls, Power Status and Monitoring, etc.).
- F. Deferred Testing: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other site conditions that prohibit the test from being performed prior to Substantial Completion.
- G. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Project Documents.
- H. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by the Contractor and witnessed by the CxA. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are operated through all specified sequences of operation. Components are verified to be responding in accordance with requirements in the Project Documents.
- I. Functional Performance Testing Procedures: Commissioning protocols, detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly.
- J. Integrated Systems Test (IST): Test of dynamic function and operation of multiple systems. Integrated Systems Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Systems and interconnections are verified to be responding in accordance with the requirements in the Project Documents.
- K. Integrated Systems Testing Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly.
- L. Operational Testing: Activities and testing occurring after initial energizing and/or start-up of equipment that determine whether equipment is operating within the manufacturer's recommendations and the design requirements. These activities are intended to ensure that equipment and systems meet all warranty requirements and are ready for Functional Performance Testing. Common examples are Testing, Adjusting and Balancing of HVAC systems and initial load testing of electrical equipment.
- M. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the expectations of how the facility will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria and supporting information.
- N. Project Documents: Consists of the Contract Documents, Approved Submittals, Requests for Information (RFI), Vendor documentation, Operations and Maintenance (O&M) information and other

documentation that determines the requirements for acceptable installation and operation of the specific equipment and systems on the project.

- O. System Verification Checklist (SVC): A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.), start-up activities and documentation, as well as operational testing results. The checklists are meant to document all activities for an individual piece of equipment from procurement on the project through operational testing are performed in accordance with the requirements in the project documents.
- P. Start-up: The activities where equipment is initially energized, tested and operated. Start-up is completed prior to Operational Testing and Functional Performance Testing and is an integral item documented in the System Verification Checklist (SVC).
- Q. Training Plan: A detailed plan prepared by the Contractor and reviewed by the Owner and Commissioning Authority that outlines the training activities, instructors, time durations, and system requirements in accordance with the Contract Documents and Commissioning Plan.
- R. Trending: Data collection of monitored points using the Building Automation System, Lighting Controls System, Power Status and Monitoring System or independent data acquisition instrumentation.

#### **1.4 COMMISSIONING TEAM**

- A. Owner shall appoint the following Members:
  - 1) Owner's Project Manager and any other designated representatives of the Owner's staff.
  - 2) Commissioning Authority (CxA)
  - 3) Architect/Engineer (A/E)
  - 4) Test, Adjust and Balance Firm (TAB) – may be sub-contracted to the CxA
- B. Contractor shall appoint the following Members:
  - 1) Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions. At a minimum, the Contractor shall designate a Commissioning Coordinator and each major sub-contractor (Mechanical, Electrical, Plumbing, Building Automation) shall have a dedicated representative.
  - 2) Vendor representatives (as needed) required for start-up, operational testing, Functional Performance Testing, Integrated Systems Testing, and Owner Training activities.
  - 3) Representatives of independent testing agencies (Test, Adjust and Balance, Electrical Testing Agency, etc.)

#### **1.5 ROLES AND RESPONSIBILITIES**

- A. Roles and responsibilities of Commissioning Team members related to the Commissioning Process are provided in this Section. The respective entities defined below shall fulfill the listed roles and responsibilities as contained herein. Specific technical roles and responsibilities are defined in other sections of the Project Specifications.
- B. Owner's Roles and Responsibilities:

- 1) Provide guidance in development of the Owner's Project Requirements (OPR).
  - 2) Review Technical Specifications containing Commissioning requirements.
  - 3) Approve the Commissioning Scope of Work and schedule of Commissioning activities.
  - 4) Assign Owner's representatives and schedule them to participate in Commissioning activities, including the following:
    - a. Commissioning Team meetings.
    - b. Review and approval of the Commissioning Plan, Training Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, Final Commissioning Process Report, Systems Manual, Measurement and Verification Plan and other Commissioning documents.
    - c. Attend Owner Training sessions in operation and maintenance of systems and equipment.
    - d. Observation of Contractor's demonstration of systems and equipment operation.
- C. Commissioning Authority's (CxA) Roles and Responsibilities:
- 1) Prepare the Commissioning Plan with the Owner's and Contractor's review and input.
  - 2) Periodically attend and/or review the proceedings of the regular Construction Meetings hosted by the Contractor to understand the progress of construction activities on the project.
  - 3) Conduct and document Commissioning Team meetings including the Commissioning Kickoff Meeting.
  - 4) Perform site visits as necessary to observe component and system installations prior to energizing or start-up of equipment and systems.
  - 5) Review and comment on product data and shop drawing submittals and coordination drawings applicable to systems being commissioned.
  - 6) Following submittal review and approvals by the A/E team, review the sequences of operation and coordinate with the Contractor and A/E Team in order to prepare the Functional Performance Test Procedures and Integrated Systems Test procedures. Submit to the Owner and Contractor for review and comment prior to facilitating FPTs and ISTs on the project.
  - 7) Upon written notice that equipment or systems are ready for initial energizing or start-up, review the progress of the System Verification Checklist(s) for the respective systems and components and ensure that all requirements have been completed by the Contractor to permit energizing or start-up in accordance with the project documents; CxA shall issue written notice to the Owner and Contractor that equipment is ready to energize or start-up. CxA will witness and ensure proper documentation is provided by the Contractor for major equipment energizing and start-ups as executed by the Contractor with appropriate notice as indicated herein.
  - 8) Witness, verify, and document results of Functional Performance Tests and Integrated Systems Tests.
  - 9) Coordinate resolution of deficiencies identified during site observations, equipment energizing or start-up, Functional Performance Testing, Integrated Systems Testing, Deferred Testing, and during the warranty period.



- 10) Review the Operating and Maintenance (O&M) documents to ensure that as-built information and correct data is included prior to the Owner Training sessions; review final O&M submittal to ensure compliance with the requirements in the project documents and provide written comments to the Owner.
- 11) Review the Contractor's Training Plan and individual training agendas for compliance with the requirements in the project documents. Recommend acceptance to the Owner prior to the Contractor scheduling training sessions with the Owner. Review the attendance and content of the training sessions to ensure the requirements of the project documents are completed. Conduct a survey of the Owner's personnel to evaluate the effectiveness of the Owner Training.
- 12) Compile the Final Commissioning Process Report and submit to the Owner for review and approval.

D. Architect/Engineer's (A/E) Roles and Responsibilities:

- 1) Specify control sequences of operation within the Contract Documents that comply with the OPR and BOD.
- 2) Incorporate Commissioning requirements into the Contract Documents if requested by the Owner.
- 3) Attend Commissioning Team meetings.
- 4) Review the Commissioning Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, and other Commissioning documents as required by the Owner or the Contract Documents.
- 5) Review Contractor's Training Plan and provide comments to the Owner.
- 6) Approve technical requirements for correction of Deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.
- 7) Review Operating and Maintenance Manuals and provide comments to the Owner.

E. Contractor's Roles and Responsibilities:

- 1) Contractor shall review and provide comments on documents produced by the Commissioning Authority, and shall accept the Commissioning Plan, System Verification Checklists, Functional Performance Test Procedures, and Integrated System Test Procedures as approved by the Owner.
- 2) Provide an individual, subject to the Owner's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Contractor's responsibilities in the Commissioning process. The Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. The Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not as Project Manager or Superintendent. Submit qualifications demonstrating the Commissioning Coordinator's technical expertise and experience to the Owner for approval. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to Owner for Owner's approval.
- 3) Furnish and install systems that meet all requirements of the Contract Documents.
- 4) Ensure that Commissioning Process activities are incorporated into the Master Project Schedule. The Contractor shall coordinate with the CxA and the Owner to determine the required activities, durations and predecessors.
- 5) Submit inspection requests, start-up requests and all supporting documentation in accordance with

the Contract Documents, General Conditions, and Commissioning Plan.

- 6) Cooperate with Owner's representative(s), provide access to work and provide adequate labor, resources, and time for Commissioning.
- 7) Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit to the Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by the factory or field technicians. This requirement does not supersede any additional requirements contained in the Contract Documents.
- 8) Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect/Engineer, Owner and CxA to attend the pre-installation meetings and pre-commissioning meetings.
- 9) Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any Deferred Testing or re-testing related to warranty work.
- 10) Correct deficiencies identified during any stage of the Commissioning process.
- 11) Coordinate with the CxA to develop the Training Plan and submit to the Owner for approval. Provide training to the Owner's personnel in accordance with the Contract Documents and the approved Training Plan. Coordinate with the Owner to schedule training sessions and coordinate subcontractor/vendor participation in all training sessions.
- 12) Perform Deferred Testing and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Testing.
- 13) Perform system maintenance during construction as specified and recommended by the Owner and send the maintenance records to the Owner for Record.
- 14) Document the equipment as it arrives onsite to ensure that the submitted and received equipment is correct as it arrives onsite, including the completion of the system verification sections pertaining to the procurement process.

## 1.6. SYSTEMS TO BE COMMISSIONED

1.6.1. The following systems shall be commissioned according to the process defined in this Section:

1.6.1.1. Major HVAC Systems (100% including but not limited to the list below)

- 1.6.1.1.1 Air Handling Units
- 1.6.1.1.2 Fan Coil Units
- 1.6.1.1.3 Exhaust Fans
- 1.6.1.1.4 Supply Fans
- 1.6.1.1.5 Pumps
- 1.6.1.1.6 Chillers
- 1.6.1.1.7 Boilers

1.6.1.2. Terminal Units (10% Sampling)

1.6.1.3. Building Automation System

1.6.1.4. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)

- 1.6.1.5. Lighting - Daylight Controls (100%)
- 1.6.1.6. Lighting - Time Switch Controls (100%)
- 1.6.1.7. Normal and Emergency Power Systems

## **PART 2 - PRODUCTS**

### **2.1. COMMISSIONING PLAN**

- 2.1.1. Document developed by the CxA that provides the structure, schedule, and coordination plan for the Commissioning Process from the Pre-construction phase through the Occupancy Phase. The Commissioning Plan shall describe the project and systems to be commissioned, Commissioning Process activities and deliverables, procedures to follow throughout the process, specific roles and responsibilities for each participant, and general description of testing and verification methods.
- 2.1.2. The Commissioning Plan shall comply with the Owner's Project Requirements (OPR).
- 2.1.3. The Commissioning Team shall review the Commissioning Plan prior to the Pre-Commissioning Meeting and submit written comments or questions to the CxA to be addressed in the meeting.
- 2.1.4. Following the Pre-Commissioning meeting, the CxA shall incorporate all changes discussed and agreed upon in the Pre-Commissioning meeting and submit the Final Commissioning Plan to the Commissioning Team for approval and acceptance.
- 2.1.5. If changes to the Commissioning Plan are needed during the Commissioning Process, the CxA shall edit the plan and distribute to the Commissioning Team for approval and acceptance.
- 2.1.6. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor. The Contractor shall ensure that all sub-contractors and vendors agree and accept the Commissioning Plan.

### **2.2. SYSTEM VERIFICATION CHECKLISTS**

- 2.2.1. System Verification Checklists (SVCs) are important to ensure that the equipment and systems are connected and operational and that Functional Performance Testing proceeds without unnecessary delays. These checklists document the inspections and procedures necessary to take a piece of equipment from a static state into an operating state. These checklists augment the manufacturer's start-up checklists to provide a complete document from procurement to the start of Functional Performance Testing when combined.
- 2.2.2. The CxA shall develop the System Verification Checklist templates for review by the Cx Team. The Contractor, appropriate Subcontractors and Vendors shall support the CxA in development of SVCs for each system and components by providing any necessary supporting documentation as requested by the CxA and reviewing and commenting on the checklist templates in accordance with the Project Specifications and the Commissioning Plan.
- 2.2.3. Once the checklist templates are reviewed and accepted, the CxA will produce checklists for all equipment and components to be commissioned on the project utilizing an electronic commissioning database that is accessible via web portal or local field tool (i.e., iPad, tablet, laptop, etc.).
- 2.2.4. The CxA shall provide login access and training to the Contractor and other members of the Cx Team in the use of the electronic commissioning database.
- 2.2.5. The Contractor shall be responsible for completing the required sections of the System Verification

Checklists utilizing the electronic commissioning database and providing all supporting documentation via electronic transmittal to the CxA. Additional requirements for completion of the SVCs are included in this section and other technical sections of the Specifications.

- 2.2.6. Once equipment arrives on the project site, the Contractor or sub-contractors shall begin completing the individual checklists and continue throughout the installation process. The checklists are meant to be progressive and a tool for tracking progress.
- 2.2.7. Once the SVCs are electronically completed, the CxA will review and approve the checklists and supporting documentation and compile the information to include in the Final Commissioning Process Report.

### 2.3. FUNCTIONAL PERFORMANCE TESTING PROCEDURES:

- 2.3.1. The purpose of the Functional Performance Testing Procedures is to verify and document that the equipment and systems on the project individually perform in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- 2.3.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of each piece of equipment and system. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.
- 2.3.3. The Commissioning Team shall review the Functional Performance Test procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Functional Performance Testing review the procedures and provide comments.
- 2.3.4. The CxA will coordinate with the Cx Team to address any comments and produce the final FPT procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.
- 2.3.5. The Contractor shall utilize the FPT procedures for any pre-testing activities prior to Functional Performance Testing.

### 2.4. INTEGRATED SYSTEMS TESTING PROCEDURES:

- 2.4.1. The purpose of the Integrated Systems Testing Procedures is to verify and document that all the integrated equipment and systems on the project perform together in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- 2.4.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of the integrated systems throughout the facility. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.
- 2.4.3. The Commissioning Team shall review the Integrated Systems Testing procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Integrated Systems Testing review the procedures and provide comments.
- 2.4.4. The CxA shall coordinate with the Cx Team to address any comments and produce the final IST procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.

- 2.4.5. The CxA shall also develop the IST personnel matrix that will be utilized to track the individual testing teams involved with the IST. The CxA will distribute the matrix to the Cx Team so that the Contractor and Owner can assign the appropriate personnel to the appropriate teams.
  - 2.4.6. The CxA shall also host a coordination meeting prior to the IST to review the IST procedures, complete any final coordination, review safety procedures, and answer any questions.
  - 2.4.7. The CxA estimates there will be two Integrated Systems Tests on the project. The first will test the Data Center systems separately and the second will test the entire facility. Requirements of the testing are included in the respective technical sections of the Project Specifications.
  - 2.4.8. The IST procedures shall be utilized by the Contractor for any pre-testing activities prior to official Integrated Systems Testing.
- 2.5. TRAINING PLAN
- 2.5.1. Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training, after reviewing the different systems to be installed and commissioned. The purpose of the Training Plan is to specifically communicate the required content and training durations required by the Owner based upon the type of equipment and the Owner's past experience.
  - 2.5.2. The Contractor shall review all of the individual technical sections of this specification for specific training requirements.
  - 2.5.3. The Contractor shall coordinate with the Owner to ensure that the proposed training requirements meet the Owner's needs and expectations.
  - 2.5.4. The Contractor shall coordinate with the sub-contractors and vendors to ensure the Owner Training requirements can be achieved and gather any additional information or recommendations.
  - 2.5.5. Any changes to the training requirements in this specification must follow contractual protocols.
  - 2.5.6. The Training Plan shall include a list of systems and equipment for which training will be provided according to the three-tiered training approach outlined in the project specifications.
  - 2.5.7. All training sessions shall have a syllabus indicating the following as a minimum in addition to any other specification requirements:
    - 2.5.7.1. Session Objectives
    - 2.5.7.2. Proposed Instructor(s)
    - 2.5.7.3. Instructor Qualifications
    - 2.5.7.4. Training Materials that will be provided
    - 2.5.7.5. Location and durations of the various parts of the training session (i.e., Classroom, On-site, etc.)
    - 2.5.7.6. Applicable specification sections and O&M Manual sections
    - 2.5.7.7. Detailed outline of training session content
  - 2.5.8. The Contractor shall coordinate with the CxA to organize the systemic training sessions comparable

to the organization of the Systems Manual.

- 2.5.9. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.

## 2.6. FINAL COMMISSIONING PROCESS REPORT

- 2.6.1. The CxA shall prepare the Final Commissioning Process Report that will include the following:

- 2.6.1.1. Executive Summary
- 2.6.1.2. Participants and Roles
- 2.6.1.3. Brief building description
- 2.6.1.4. Overview of commissioning and testing scope
- 2.6.1.5. General description of testing and verification methods
- 2.6.1.6. Appendices with supporting information, issues log, and communications

- 2.6.2. The Contractor shall coordinate with the CxA to provide any additional information that may be needed to complete the Final Commissioning Process Report.

- 2.6.3. The Contractor shall resolve any outstanding commissioning items prior to the CxA preparing the final commissioning report.

- 2.6.4. The CxA shall issue the Final Commissioning Process Report to the Cx Team for review. The Owner shall approve the Final Commissioning Process report after any comments or discrepancies are resolved by the CxA.

## PART 3- EXECUTION

### 3.1. PROJECT SCHEDULE

- 3.1.1. The Contractor shall integrate all Commissioning activities into the detailed Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite the Commissioning Process.

### 3.2. COMMISSIONING TEAM MEETINGS

- 3.2.1. Upon obtaining Owner's approval of the Commissioning Plan, the CxA shall coordinate with the Cx Team to schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved in the Commissioning process. This meeting should include the major subcontractors, specialty manufacturers/suppliers, Architect/Engineer, Test, Adjust, and Balance (TAB) Firm, Electrical Testing Agency, and Owner's representatives as participants.

- 3.2.2. Contractor shall prepare for the Pre-Commissioning Meeting by supplying the following documents created by the CxA to all applicable sub-contractors and vendors: Commissioning Plan, Example System Verification Checklists, Example Functional Performance Test Procedures and Example Integrated Systems Test Procedures.

- 3.2.3. The CxA shall conduct the Pre-Commissioning Meeting and review all aspects of the Commissioning Plan and applicable specifications.

- 3.2.4. The Commissioning Plan shall be reviewed with all attendees and the scope of work discussed. Contractor should be prepared to distribute copies of the pertinent sections to the various subcontractors involved in the Commissioning process.
  - 3.2.5. The final outcome of the meeting shall be an understanding of the commissioning process, roles and responsibilities, and consensus acceptance of the Commissioning Plan by the Cx Team.
  - 3.2.6. The Contractor may request additional meetings with the CxA and individual sub-contractors to clarify roles, responsibilities and procedures as needed.
- 3.3. TEST EQUIPMENT
- 3.3.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment.
  - 3.3.2. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
- 3.4. REPORTING
- 3.4.1. Beginning at the procurement stage for the equipment included in the Cx scope, the Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of construction progress and scheduling changes.
  - 3.4.2. Contractor shall submit Deficiency reports to the Owner within five (5) days of the deficiency occurrence. This includes responses to items noted by the Commissioning Authority.
- 3.5. DEFICIENCY RESOLUTION
- 3.5.1. The CxA shall document any issues noted during observation or testing activities in the Commissioning Issues Log (CxIL). The CxIL shall be distributed electronically to the Cx Team at regular intervals.
  - 3.5.2. The Contractor shall respond in writing to the CxA within 10 days to all new CxIL items regardless of the disposition. This response does not constitute a request for re-verification, only an acknowledgement of the outstanding item. The Contractor should utilize CxIL responses to update the Cx Team on the progress of deficiency resolution.
  - 3.5.3. The Contractor shall respond to the CxA and the Owner indicating CxIL items that are completed and ready for the CxA to verify completion.
  - 3.5.4. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete Cx Issues Log items.
- 3.6. REQUEST FOR ENERGIZING / START-UP OF EQUIPMENT
- 3.6.1. The Owner and/or Owner's representative may install lockout devices on equipment in addition to the Contractor's lockout / tagout devices once permanent power is connected to the facility. This lock would be removed once the proper start-up notification is received by the Owner and/or CxA, and the CxA has reviewed the appropriate SVCs and supporting documentation to verify the

equipment is ready for energizing and/or start-up.

- 3.6.2. These requirements do not supersede any additional requirements noted elsewhere in the Contract Documents or as required by applicable code authorities.
  - 3.6.3. Contractor shall notify Owner and CxA in writing to request initial energizing and/or start-up of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled start-up.
  - 3.6.4. Contractor shall complete the applicable sections of the System Verification Checklist(s) evidencing the Contractor's thorough inspection of the system and readiness for start-up activities as required by the Project Documents and the Commissioning Plan. Contractor shall submit required supporting documentation to the Owner and/or CxA, including but not limited to, factory testing reports, alignment reports, electrical testing reports and any other documentation required by the Project Documents prior to energizing and/or start-up.
  - 3.6.5. The CxA shall review the SVCs and supporting documentation within the 72-hour notice period and confirm in writing that the systems and equipment are approved to proceed with energizing and start-up.
  - 3.6.6. The CxA and/or owner may witness equipment energizing and/or start-up at the scheduled time, but witness is not required, unless noted elsewhere in the Specifications, as long as written approval is received as noted herein.
  - 3.6.7. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and Project Document requirements.
  - 3.6.8. Contractor shall complete all required factory start-up documentation and applicable items in the System Verification Checklists, prior to startup, to ensure compliance with the requirements in the Project Documents.
- 3.7. OPERATIONAL TESTING
- 3.7.1. Once the appropriate start-up activities are completed, the Contractor shall complete all necessary operational testing requirements included in the Project Documents prior to Functional Performance Testing. Specific requirements for systems and equipment are included in other technical sections of the Specifications.
  - 3.7.2. Contractor shall complete all operational testing items in the System Verification Checklist and submit all supporting documentation to the Owner and/or CxA for review.
  - 3.7.3. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).
  - 3.7.4. Contractor shall clearly list outstanding items or System Verification Checklist items not completed successfully. Contractor shall obtain from Subcontractor or vendor completed forms documenting any outstanding deficiencies within five (5) days of completion of energizing and/or start-up activities.
  - 3.7.5. Contractor shall review completed deficiencies to determine if outstanding items prevent execution of the Functional Performance Tests and shall issue any necessary responses to the Owner and/or Commissioning Authority.
  - 3.7.6. Contractor shall notify Owner and CxA in writing to request Functional Performance Testing of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled



activities. Owner may require Contractor to reschedule Functional Performance Testing to ensure availability of Owner's representative(s) as needed.

- 3.7.7. The CxA shall review the SVCs and supporting documentation within the 72-hour notice period and confirm in writing that the systems and equipment are approved to proceed with Functional Performance Testing.
- 3.7.8. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete System Verification Checklist items.

### 3.8. CONTROL POINT AND SENSOR CALIBRATION VERIFICATION

- 3.8.1. Automation systems installed on the project must be fully verified for point integrity and sensor calibration prior to Functional Performance Testing. Additional requirements for this verification are listed in other technical sections of the Specifications.
- 3.8.2. The Contractor shall verify these points according to the requirements in the project documents as part of start-up and operational testing of systems.
- 3.8.3. The TAB contractor shall independently verify each sensor and point and document the results to be included in the Final TAB Report.
- 3.8.4. The CxA will witness, at their discretion, this verification and/or independently verify and document the results to be included in the Final Commissioning Process Report.
- 3.8.5. These activities must be completed prior to the Contractor requesting Functional Performance Testing as indicated herein.

### 3.9. FUNCTIONAL PERFORMANCE TESTING

- 3.9.1. The objective of Functional Performance Testing is to demonstrate that each system operates according to the requirements in the Project Documents and meets the OPR and BOD.
- 3.9.2. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with the Project Documents, the Commissioning Plan and applicable Functional Performance Testing procedures.
- 3.9.3. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.
- 3.9.4. The CxA and members of the Cx Team, including the Owner's personnel, may observe Functional Performance Testing of equipment components and systems. The CxA shall facilitate the Functional Performance Testing activities according to the accepted FPT procedures and record the results of all testing activities.
- 3.9.5. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Functional Performance Testing.
- 3.9.6. All Functional Performance Testing of Integrated Systems must be completed in accordance with the Project Documents and the Commissioning Plan prior to the Contractor scheduling the Integrated Systems Testing activities.

### 3.10. INTEGRATED SYSTEMS TESTING

- 3.10.1. The objective of Integrated Systems Testing is to demonstrate that each integrated system operates jointly and/or independently of other systems according to the requirements in the Contract Documents.
- 3.10.2. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (fire alarm integration with HVAC, emergency power modes, equipment failures among related systems, etc.) according to the accepted Integrated Systems Testing procedures developed by the CxA. The CxA shall facilitate and document the testing, organizing the appropriate testing teams and providing sufficient instruction to all participants to conduct efficient and effective testing activities.
- 3.10.3. Integrated Systems Testing typically involves multiple teams with representation from the CxA, Owner, and Contractor. The Contractor shall provide any needed communication equipment (i.e., radios) or make available any centralized intercom or paging system for communication with all testing groups.
- 3.10.4. The Contractor shall provide no less than 7 days (not including weekends or holidays) notice when requesting to conduct the Integrated Systems Testing. All personnel must be assigned to the Personnel Matrix by the CxA and a coordination meeting held within the 7 day period as prescribed elsewhere in this section.
- 3.10.5. Contractor conducts Integrated Systems Testing after all applicable Functional Performance Testing is satisfactorily completed and approved by the Owner and/or CxA.
- 3.10.6. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Integrated Systems Testing.

### 3.11. DEMONSTRATION AND OWNER TRAINING

- 3.11.1. The Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training as required throughout various sections of the Project Specifications.
- 3.11.2. The specific requirements for scheduling and conducting the Owner Training are included in other sections of this Specification.
- 3.11.3. Owner Training activities shall not occur until the Training Plan is approved by the Owner and the Contractor has submitted all O&M information for review and use during the training sessions.
- 3.11.4. The Contractor shall notify the CxA of all training sessions. The Contractor shall record attendance of the training sessions and the Owner shall ensure the appropriate personnel are in attendance.
- 3.11.5. The CxA shall ensure the content of the Owner Training sessions meets the requirements in the Project Documents.
- 3.11.6. The CxA may conduct surveys of the Owner's personnel to gauge the effectiveness of the Owner training sessions. If unfavorable surveys are received by the Owner's personnel indicating unsatisfactory training, the Owner reserves the right to require the Contractor to re-train in those specific areas of non-conformance until the requirements in the Project Documents are satisfactorily completed.

- 3.11.7. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.
- 3.12. DEFERRED / SEASONAL TESTING
  - 3.12.1. All Construction phase requirements of the Commissioning Process must be completed prior to Substantial Completion or as indicated elsewhere in this Specification.
  - 3.12.2. If any testing or other requirements cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon approval of the Owner. Contractor shall reschedule testing according to the protocols described in this section and any other operational protocols prescribed by the Owner.
  - 3.12.3. Contractor shall complete all outstanding commissioning requirements as part of this Contract during the warranty period. Contractor shall schedule all activities with Owner and/or CxA.
  - 3.12.4. The CxA shall document any deferred testing activities and ensure the appropriate commissioning documents are updated. The Contractor shall provide any additional documentation needed by the CxA to complete these requirements.

**END OF SECTION**

## **SECTION 02 41 00 - DEMOLITION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Demolition and removal of buildings and site elements.

#### **1.3 DEFINITIONS**

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.
- B. Existing to Remain: Leave existing items that are not scheduled for salvage or reuse, as is; do not remove.
- C. Deconstruct: To remove by disassembling or detaching an item from a surface, using methods and equipment to successfully prevent damage to the item and surfaces; and dispose of items unless indicated as salvaged or for reinstallation.

#### **1.4 MATERIALS OWNERSHIP**

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and the contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner. Salvage to prevent damage and promptly return to Owner.

#### **1.5 PREINSTALLATION MEETINGS**

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Review structural load limitations of existing structures.
  - 2. Review and finalize protection requirements.
  - 3. Review procedures for noise control and dust control.
  - 4. Review procedures for protection of adjacent buildings.

#### **1.6 SUBMITTALS**

- A. Qualification Data: Submit copies of qualifications for refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including Drawings, indicating proposed measures for protecting individuals and property, for environmental protection, dust control and noise control. Indicate proposed locations, types, and construction of barriers.
- C. Schedule of Activities:
  - 1. Detailed sequence of work, with starting and ending dates for each activity. Ensure Owner's on site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that could be construed as damage caused by demolition operations. Submit prior to commencement of the work.
- E. Statement of Refrigerant Recovery: Submit statement signed by refrigerant recovery technician responsible for recovering refrigerant, stating that refrigerant present was recovered and recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

#### **1.7 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Demolition Standards: Comply with ASSE A10.6 and NFPA 241.
  2. Comply with EPA regulations prior to commencement of the work. Comply with hauling and disposal regulations of authorities having jurisdiction.
  3. Comply with applicable federal, state, and local codes for demolition work, dust and noise control, safety of structure, and debris removal.
  4. Obtain required permits from authorities having jurisdiction.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA approved certification program.

#### **1.8 FIELD CONDITIONS**

- A. Owner will occupy portions of building immediately adjacent to Work area. Conduct Work so Owner's operations will not be disrupted. Provide minimum of 72 hours' notice to Owner of activities that will affect Owner's operations including but not limited to:
  1. Interruption of power.
  2. Interruption of utility services.
  3. Excessive noise.
- B. Condition of Structure: Conditions existing at time of inspection will be maintained by Owner as far as practical. Owner assumes no responsibility for actual condition of items or structures to be demolished.
  1. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not anticipated that hazardous materials will be encountered in the Work.
  1. Hazardous materials will be removed by Owner before start of the Work.
  2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by at least 12 inches (300 mm).
- E. Storage or sale of removed items or materials on site is not permitted.

- F. Traffic: Conduct operations and debris removal to ensure minimum interference with roads, streets, drives, fire lanes, walks, accessible paths, and adjacent occupied or used facilities.
  - 1. Do not close, block, or obstruct streets, drives, walks, or occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around obstructed traffic ways.
- G. Explosives: Explosives are not permitted at the site.
- H. Flame Cutting: Do not use cutting torches for removal until flammable materials are removed. At concealed spaces, verify conditions prior to flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.
- I. Environmental Controls: Use water sprinkling, temporary enclosures, or other acceptable methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions.
- J. Utility Services: Maintain existing utilities and protect against damage during demolition operations.
  - 1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, acceptable to Owner and governing authorities.
- K. Protections: Provide temporary barriers to protect Owner's personnel and public from injury from work.
  - 1. Take protective measures to provide free and safe passage to occupied portions of building.
  - 2. Provide protection to ensure safe passage of the Owner's personnel and the public around demolition areas and to and from occupied portions of adjacent areas, buildings, and structures.
  - 3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
  - 4. Protect existing work which becomes exposed during demolition operations.
    - a. Protect existing improvements, appurtenances, and conditions to remain.
    - b. Protect adjacent floors with coverings.
    - c. Protect walls, openings, roofs, and adjacent exterior construction to remain and exposed to building demolition operations.
  - 5. Construct temporary insulated dustproof partitions to separate areas from noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks. Refer to Drawings for location of partitions to be provided.
  - 6. Provide temporary weather protection when exposing exterior conditions to prevent water leakage or damage to structure or interior areas of existing building.
- L. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

## **1.9 COORDINATION**

- A. Arrange selective demolition schedule to avoid interference with Owner's and the school's operations.

## **1.10 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor prior to proceeding. Existing warranties to be provided by Owner prior to the start of construction.

- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying existing system has been inspected and warranty remains in effect. Submit supporting documentation at closeout.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

### **2.2 MATERIALS**

- A. Repair Materials: Use repair materials identical to existing materials.
  - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that affected utilities have been disconnected and capped before commencing selective demolition operations.
- B. Review Project Record Documents of existing construction or existing condition and hazardous material information provided by Owner. Owner does not warrant existing conditions are same as those indicated in Project Record Documents.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for detensioning.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions with measured drawings or preconstruction photographs or video and templates.
  - 1. Inventory and record the condition of items to be removed. Provide photographs or video of conditions that might be misconstrued as damage caused by operations.
  - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
  - 3. For any electrical or low-voltage work to be performed in the project (including fire alarm, PA, intercom, or data), test entire system for operation prior to initiation of work. Notify Owner of any non-working components. Test entire system at the end of construction to ensure all systems operate properly.

### **3.2 PREPARATION**

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
- B. Pest Control: Employ certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

- C. Site Access and Temporary Controls: Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities. Comply with requirements for access and protection.
- D. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling.
- E. Furnishings and Equipment: Cover and protect furniture, equipment, and fixtures from spoilage or damage as necessary.
- F. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
  - 1. Construct dustproof partitions of not less than nominal 4 inch (100mm) studs, 5/8 inch (16mm) gypsum wallboard with joints taped on occupied side, and 1/2 inch (13mm) fire retardant plywood on the demolition side.
  - 2. Insulate partition to provide noise protection to occupied areas.
  - 3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
  - 4. Protect air handling equipment.
  - 5. Weatherstrip openings to prevent the spread of dust.
- G. The contractor shall segregate the non-friable asbestos containing black moisture barrier mastic material and dispose of accordingly. Contractor shall provide NESHAP-trained individuals on site during this process. The Contractor's NESHAP-trained individuals will keep the asbestos containing materials wet, demarcate the area, and line the dumpsters with true 6-mil poly. Contractor will be responsible for transporting the asbestos material to an acceptable landfill. The Contractor will supply all barricade material, water, hoses, poly, dumpsters, PPE, transporting trucks and other **asbestos** related incidentals to complete the work. Material shall be kept wet at all times and no visible emissions will be allowed. All DSHS, TCEQ, EPA, DOT, OSHA and other applicable regulations shall be followed.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  - 4. Cut off pipe or conduit a minimum of 24 inches (610 mm) below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
  - 5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.



6. Disconnect, demolish, and remove fire suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
  - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
  - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - e. Equipment to Be Removed: Disconnect and cap services and remove equipment and deliver to Owner.
  - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations including, but not limited to SCAQMD Rule 403 (Fugitive Test).
  1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
  2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

### 3.5 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
  1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
  2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
    - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Provide temporary barricades and protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
    - a. Erect temporary pathways and means of egress necessary for ongoing operations compliant with Code and accessibility regulations.
    - b. Provide temporary barricades and protection required to prevent injury and damage to adjacent buildings and facilities to remain.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
    - a. Protect existing work which becomes exposed during demolition operations.

- b. Protect adjacent entrances from damage due to demolition activities.
  - c. Protect existing improvements, appurtenances, and conditions to remain.
  - d. Protect floors with covering.
  - e. Protect walls, openings, roofs, and adjacent exterior construction to remain and exposed to building demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00.
    - a. Construct temporary insulated dustproof partitions to separate areas from noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks.
    - b. Construct dustproof partitions of not less than nominal 4 inch (100mm) studs, 5/8 inch (16mm) gypsum wallboard with joints taped on occupied side, and 1/2 inch (13mm) fire retardant plywood on the demolition side.
    - c. Insulate partition to provide noise protection to occupied areas.
    - d. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
    - e. Protect air handling equipment.
    - f. Weatherstrip openings.
  6. Damage: Promptly repair damages to adjacent components cause by demolition activities.
- D. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- E. Remove temporary barricades and protections where hazards no longer exist.

### **3.6 SELECTIVE DEMOLITION**

- A. Demolish and remove existing construction to the extent necessary for new work. Use methods required to complete the work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.
  5. Maintain fire watch during and for at least 24 hours after flame cutting operations.
  6. Maintain adequate ventilation when using cutting torches.
  7. Remove decayed, vermin infested, and dangerous or unsuitable materials and promptly dispose of offsite.
  8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  9. Locate selective demolition equipment and remove debris and materials to avoid imposing excessive loads on supporting walls, floors, or framing.
  10. Dispose of demolished items and materials promptly.

- B. Site Access and Temporary Controls: Conduct selective demolition and debris removal operations to ensure minimum interference with roads, streets, walks, walkways, and adjacent occupied and used facilities.
- C. Patching and Repair: Repair damage to adjacent construction caused by selective demolition operations promptly.

### 3.7 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs on Grade: Saw cut perimeter of area to be demolished, and then break up and remove.
- E. Interior Slab on Grade: Use best practice removal methods to prevent cracking or structurally disturbing adjacent slabs or partitions. Use power saw where possible.
- F. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in *RFCI Recommended Work Practices for the Removal of Resilient Floor Coverings*. Do not use methods requiring solvent-based adhesive strippers.
- G. Below Grade Voids: Completely fill below grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 (150mm) inches in diameter, roots, or other organic matter.
- H. Partitions: Completely remove indicated interior partitions and interior finishes indicated. Leave adjacent work scheduled to remain sound and ready for patching or for new finishes.
- I. Doors and Frames: Remove doors, frames, and hardware where indicated. Remove from site.
  - 1. Remove doors, frames, and hardware where indicated. Clean, store, and protect for reinstallation or return hardware to Owner as directed.
- J. Cut existing masonry walls for new doors, windows, or openings indicated. Leave openings ready to receive new work or patching.
- K. Windows: Remove existing windows where indicated. Remove associated anchors, shims, blocking, operating devices, sealant, and trim. Cut back interior finishes required for plumb surface for patching. Leave openings ready for installation of new materials and finishes.
- L. Mechanical, Electrical, and Structural Elements: If unanticipated mechanical, electrical, or structural elements conflicting with intended function or design are encountered, investigate and measure both nature and extent of the conflict.
  - 1. Submit written report to Architect in accurate detail. Pending receipt of directive, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.
  - 2. HVAC Equipment: Remove air conditioning equipment without releasing refrigerants.

### **3.8 REMOVAL OF STRUCTURAL ELEMENTS**

- A. Foundation: Demolish foundation walls to a minimum depth of 12 inches (300mm) below existing ground surface. Demolish and remove below grade wood or metal construction. Break up below grade concrete slabs.
- B. Pneumatic Operated Hammers: When possible, reduce use of pneumatic operated hammers. When necessary to use pneumatic tools, locate compressors as remote from occupied areas as possible.
  - 1. To break large pieces of concrete, isolate concrete from floor slabs and building structure to prevent structure borne vibration.
- C. Saw Cutting: Locate compressors as remote as possible from occupied areas of facility.
  - 1. Use diamond tipped saw blades and related equipment.
  - 2. Saw cut portions of walls and slabs. Angle saw blade at floors and corners to cut as closely as possible to desired location.
  - 3. Control runoff water used with saw to prevent damage to existing materials.

### **3.9 DEMOLITION BY MECHANICAL MEANS**

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.

### **3.10 PATCHING AND REPAIRS**

- A. Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Repairs: When necessary to repair existing surfaces, patch to produce surfaces suitable for new materials.
  - 1. Fill holes and depressions in existing masonry walls to remain with masonry patching material applied according to manufacturer's written recommendations.
- C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- D. Floors and Walls: Where walls or partitions are demolished, extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  - 1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  - 2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
  - 3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

- E. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

**3.11 DISPOSAL OF DEMOLISHED MATERIALS**

- A. Legally remove demolition waste materials from site and dispose in an EPA approved construction and demolition waste landfill acceptable to authorities having jurisdiction recycle or reuse components.
  - 1. Do not allow demolished materials to accumulate on site.
  - 2. Remove and transport debris to prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or devices that convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

**3.12 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION 02 41 00**

**SECTION 02 41 00 - DEMOLITION**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Demolishing and removing existing pavement, structures, equipment, and materials as shown on the plans.
- B. Disposal of demolished materials and equipment.

**1.2 UNIT PRICES**

- A. Removing and disposing of asphalt or concrete pavement including curb, base and sub-base material shall be measured and paid for by the square yard without regard to thickness and the measurement shall include all labor and materials including breaking up the asphalt pavement, hauling, unloading, and disposal.
- B. Removing and disposing of concrete sidewalk and pavement including subgrade material shall be measured and paid for by the square foot without regard to thickness and the measurement shall include all labor and materials including breaking up the concrete pavement, hauling, unloading, and disposal.
- C. Sawed cuts shall be measured and paid for by the linear foot and the measurement shall include all equipment, labor and materials.
- D. Removing and disposing of storm sewer piping, manholes, and related appurtenances shall be measured and paid for by the unit specified in the bid form for the appropriate item and shall include all labor and materials for removal and disposal.

**1.3 PAYMENT**

- A. The work performed and materials furnished as prescribed by this item shall be paid for at the contract unit price bid for the following item:
  - Removal of Reinforced Concrete Pavement per S.Y.
- B. The removal of sidewalks shall be paid for as a component of the contract unit price bid for the following item:
  - Removal of Concrete Sidewalk per S.F.
- C. The work performed and materials furnished as prescribed by this item shall be paid for at the contract unit price bid for the following item:
  - Removal of Asphalt Pavement per S.Y.
- D. The removal of storm sewer piping, manholes, and related appurtenances shall be paid for at the contract unit price bid for the applicable item.
- E. The unit price bid for each item shall be full compensation for furnishing all equipment, labor, disposal fees, and materials needed to complete the work in accordance with the Contract Documents.

#### **1.4 ENVIRONMENTAL CONTROLS**

- A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt, and debris.
- B. Use appropriate controls to limit noise from demolition to acceptable levels.
- C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.
- D. Stop demolition and notify Engineer if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.
- E. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Dispose of removed equipment, materials, waste, and debris in a manner conforming to applicable laws and regulations.

### **PART 2 PRODUCTS**

#### **2.1 EQUIPMENT AND MATERIALS FOR DEMOLITION**

- A. Fires shall not be permitted.
- B. The use of a "drop hammer" shall not be permitted where the potential for damage to underground utilities exists.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Prior to demolition, make an inspection with Engineer to determine the condition of existing structures and features adjacent to items designated for demolition.
- B. Engineer will mark or list existing equipment to remain on the property of the Owner.
- C. Do not proceed with demolition or removal operations until after the joint inspection and subsequent authorization by Engineer.

#### **3.2 PROTECTION OF PERSONS AND PROPERTY**

- A. Provide safe working conditions for employees throughout demolition and removal operations. Observe all safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings at all times. Do not obstruct roadways, sidewalks, or passageways adjacent to the work.
- C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to Owner's property or adjacent property and facilities.
- D. The Contractor shall be responsible for the safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered.

Resume demolition only after proper protective measures have been taken.

- E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

**3.3 UTILITY SERVICES**

- A. Follow rules and regulations of authorities or utility companies having jurisdiction over water, natural gas, electricity, or telephone services.
- B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

**3.4 DISPOSAL**

- A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage.
- B. Follow method of disposal as required by regulatory agencies.

**3.5 BACKFILL**

- A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to density of adjacent soil.
- B. Do not backfill with material from demolition unless approved by Engineer.

**END OF SECTION 02 41 00**



## **SECTION 02 41 13.10 - REMOVING EXISTING PAVEMENT AND STRUCTURES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Removing concrete paving, asphaltic concrete pavement, and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks, and driveways.
- C. Removing pipe culverts and sewers.
- D. Removing existing inlets and manholes.
- E. Removing miscellaneous structures of concrete or masonry.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for removing and disposing of asphaltic surfacing and unreinforced concrete base under asphaltic surfacing, regardless of the thickness encountered, is on a square yard basis measured between lips of gutters.
  - 2. Payment for removing and disposing of concrete base under surfacing with curbs, regardless of the thickness encountered, is on a square yard basis measured from back-to-back of curbs. Payment includes removal of all concrete base, asphaltic surfacing, concrete pavement, esplanade curbs, curb and gutters, and paving headers.
  - 3. Payment for removing and disposing of reinforced concrete pavement, regardless of its thickness, is on a square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.
  - 4. Payment for removing and disposing of monolithic curbs and gutters, and concrete curbs, is on a linear foot basis measured along the face of the curb.
  - 5. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on a square yard basis.
  - 6. Payment for removing and disposing of concrete sidewalks is on a square yard basis.
  - 7. Payment for removing and disposing of concrete driveways is on a square yard basis.
  - 8. Payment for removing and disposing of miscellaneous concrete and masonry is on a cubic yard basis of the structure in place.
  - 9. Payment for removing and disposing of pipe culverts and sewers is on a linear foot basis for each diameter and each material type of pipe removed.
  - 10. Payment for removing and disposing of existing inlets is on a unit price basis for each inlet removed.
  - 11. Payment for removing and disposing of existing manholes is on a unit price basis for each manhole removed.
  - 12. Payment for saw cutting of existing pavement is on a linear foot basis.
  - 13. No payment will be made for work removed without the Engineer's approval or for pavements or structures removed for the Contractor's convenience.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

### **1.3 REGULATORY REQUIREMENTS**

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

### **PART 2 PRODUCTS – Not Used**

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Obtain advance approval from Engineer for dimensions and limits of removal work.
- B. Identify known utilities below grade. Stake and flag locations.

#### **3.2 PROTECTION**

- A. Protect the following from damage or displacement:
  - 1. Adjacent public and private property.
  - 2. Trees, plants, and other landscape features designated to remain.
  - 3. Utilities designated to remain.
  - 4. Pavement and utility structures designated to remain.
  - 5. Bench marks, monuments, and existing structures designated to remain.

#### **3.3 REMOVALS**

- A. Remove pavements and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of two (2) inches.
- D. Where street and driveway saw cut locations coincide or fall within three (3) feet of existing construction or expansion joints, break out to existing joint.
- E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install an 8-inch thick masonry plug in pipe end prior to backfill.

#### **3.4 BACKFILL**

- A. Backfill of removal areas shall be in accordance with requirements of Division 31.

**3.5 DISPOSAL**

- A. Inlet frames, grates, plates, and manhole frames and covers may remain property of the Owner. Disposal shall be in accordance with requirements of Section 01 74 19 – Construction Waste Management and Disposal.
- B. Remove from the site debris resulting from work under this section in accordance with requirements of Section 01 74 19 - Construction Waste Management and Disposal.

**END OF SECTION 02 41 13.10**

## **SECTION 02 41 13.11 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Disposal of waste material and salvageable material.

#### **1.2 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Contractor shall obtain all required permits prior to disposal of excess material in areas designated as being in "100-year Flood Hazard Area."
- C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.
- D. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit written and signed release from property owner upon completion of disposal work.
- E. Describe waste materials expected to be stored on-site and a description of controls to reduce Pollutants from these materials, including storage practices to minimize exposure of materials to storm water; and spill prevention and response measures in the Project's Storm Water Pollution Prevention Plan (SWPPP). Refer to Division 1.

### **PART 2 PRODUCTS -Not Used**

### **PART 3 EXECUTION**

#### **3.1 SALVAGEABLE MATERIAL**

- A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.
- B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material designated for salvage into Owner's designated trucks.
- C. Pipe Culvert: Load culverts designated for salvage into Owner's designated trucks.
- D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.
- E. Coordinate loading of salvageable material on Owner's trucks with Owner's Representative.
- F. The Contractor shall dispose of all items the Owner refuses in conformance with the requirements of Division 1 at no additional cost to the Owner.

### **3.2 EXCESS MATERIAL**

- A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.
- B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner. See Paragraph 1.02 D above.
- C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless a permit has been obtained. Remove excess material placed in "100-year Flood Hazard Area" without a permit, at no additional cost to the Owner.
- D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

**END OF SECTION 02 41 13.11**

## **SECTION 02 41 16 - STRUCTURE DEMOLITION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Demolition and removal of buildings and site improvements.
  - 2. Abandoning in-place or removing below-grade construction.
  - 3. Salvaging items for reuse by Owner.

#### **1.3 DEFINITIONS**

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

#### **1.4 QUALIFICATIONS**

- A. Demolition Subcontractor
  - 1. The demolition subcontractor shall meet the following qualification requirements:
    - a. The demolition subcontractor company shall have a minimum of five (5) years of demolition and temporary shoring experience of similar size, scale, and complexity of the demolition work involved in this project.
    - b. The site superintendent or foreman shall have the same required experience.
    - c. At a minimum, a demolition subcontractor shall have a representative who has completed OSHA 30 training and be present on site during all demotion and temporary shoring activities.
    - d. Any demolition subcontractors with OSHA violations within the past 5 years or are under active OSHA investigations will not be considered qualified for structural demolition.
  - 2. In cases where the general contractor wishes to employ multiple demolition subcontractors for various demolition scope, all demolition subcontractors shall meet the above qualifications.
- B. Demolition And Temporary Shoring Delegated Design Engineer
  - 1. The structural EOR is not responsible for the design of any temporary shoring or bracing required between demolition and the installation of the new structure. The demolition and temporary shoring delegated design engineer shall be a licensed professional engineer in the state of Texas who specializes in Demolition and temporary structures. The delegated design engineer is responsible for the following:
    - a. Provide a letter stating that they fully understand the scope of work required from all disciplines.

- b. Shoring plans and demolition plans, which includes sequence of shoring, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
- c. Excavation support and protection system plans, which includes sequence of support & protection system, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
- d. Perform periodic site visits which include various milestones for the demolition and shoring subcontractors and shall provide observation report, photos, etc. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed. Measurements shall be taken at milestones.

#### **1.5 MATERIALS OWNERSHIP**

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

#### **1.6 PREINSTALLATION MEETINGS**

- A. Predemolition Conference: Conduct conference at Project site or location or method as mutually agreed upon.
  - 1. Inspect and discuss condition of construction to be demolished.
  - 2. Review structural load limitations of existing structures.
  - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review and finalize protection requirements.
  - 5. Review procedures for noise control and dust control.
  - 6. Review procedures for protection of adjacent buildings.
  - 7. Review items to be salvaged and returned to Owner.
  - 8. Site walk of all areas of selective demolition activities with the structural engineer of record, architect, owner, general contractor, and demolition subcontractor representatives overseeing demolition work in attendance.
    - a. GC shall have removed superficial/architectural coverings so that structure is visible during site walk.

#### **1.7 OAC MEETINGS**

- A. The General Contractor shall provide a “two-week look ahead” to indicate upcoming areas where demolition work is scheduled to take place, so all parties are aware of timeline and any coordination with architect and consultants can take place. The highlighted plan should be completed by the General Contractor (in conjunction with their demolition subcontractor) and be available for discussion at the weekly OAC meeting.

#### **1.8 INFORMATIONAL SUBMITTALS**

- A. Engineering Survey: Submit engineering survey of condition of building.

- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
  - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.
- C. Schedule of Building Demolition Activities: Indicate the following:
  - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
  - 2. Temporary interruption of utility services.
  - 3. Shutoff and capping or re-routing of utility services.
  - 4. Refer to Section 1.7 for “two-week look ahead” requirement at OAC meetings.
- D. Pre-demolition photographs or videos showing existing conditions for any existing walls or new openings in existing walls, floors, and/or roofs scheduled to be demolished for the structural EOR's review and approval prior to the start of demolition. Photos must show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. The locations of pre-demolition photographs & videos shall be identified on an accompanying plan view.
- E. For Information Only Submittal: Demolition Sub-Contractor(s) qualifications required prior to demolition work commencing. Provide the following documentation:
  - 1. Demolition Subcontractor Company(s):
    - a. Provide the company's project experience in structural demolition for the past 5 years including the scope of work they performed and references with contact information.
    - b. Disclosure of any OSHA violations within the past 5 years and/or any active OSHA investigations.
    - c. Any company name changes for the past 10 years.
  - 2. Demolition site superintendent(s) / foreman(s)
    - a. Provide the names of the structural demolition site superintendent(s) / foreman(s), their project experience for the past 5 years including the scope of work they performed and references with contact information
    - b. Proof of the individuals' completion of OSHA 30 training.
- F. For Information Only Submittal: Demolition & temporary shoring delegated design engineer letter stating they fully understand the scope of work required from all disciplines.
- G. Delegated-Design Submittal: Shoring plans and demolition plans, which includes sequence of shoring, sequence of demolition, and duration of both signed and sealed by the temporary shoring professional engineer responsible for their preparation.
  - 1. Locations for each shoring and demolition event provided in the sequence of shoring and demolition shall be indicated on the shoring and demolition plan to avoid any confusion as to where these activities should occur.
  - 2. These plans shall include the general contractors' field verification comments as described in Section 1.10 Field Conditions.
- H. Delegated-Design Submittal: For temporary shoring system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. This shall be submitted with the shoring and demolition plan delegated-design submittal.



1. Provide a plan with temporary shoring system locations, the amount of load the shoring system will see at each location, the type shoring system used at each location, product data showing the load rating for each shoring tower type used on the project.
- I. For Information Only: Observation reports with site photos for periodic site visits at various demolition and shoring milestones prepared by the demolition and temporary shoring delegated design engineer.
  1. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed.
  2. Measurements shall be taken at milestones.
- J. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

#### **1.9 CLOSEOUT SUBMITTALS**

- A. Inventory: Submit a list of items that have been removed and salvaged.

#### **1.10 QUALITY ASSURANCE**

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

#### **1.11 FIELD CONDITIONS**

- A. All existing structure shown on the plans are based on limited existing drawings / as-builts of the existing building, in-person site observations, and assumed framing based on the floor plan layout and may not be entirely accurate, complete, or representative of existing conditions. The general contractor shall not demolish any walls, columns, framing, wall openings, floor openings, or roof openings that are not shown and noted to be demolished on the structural demo plans, regardless of if these items are shown to be demolished on the architectural demo plans or any other disciplines' demo plan without structural engineer-of-record (EOR) review & approval. Care should be taken during demolition to avoid damaging any structural elements that have been designated to remain.
- B. The general contractor shall field verify the location and size of all structural members shown on the plans prior to beginning any demolition work. Gridlines are shown on the structural drawings, and these reflect assumed architectural and structural dimensions. In most cases, grid lines coincide with existing column and pilaster centerlines. If actual field dimensions, or the location and sizes of existing structural members vary, notify the architect, structural EOR, and demolition & temporary structures delegated design engineer. The contractor shall notify the structural EOR of questionable existing structural components (masonry walls, steel beams and lintels, exposed foundations, etc.) and framing connections when encountered. The contractor shall verify that any wall, masonry or otherwise, to be demolished is a non-load bearing wall prior to beginning demolition. If a wall is found to be load bearing, the contractor shall contact the architect and structural EOR before proceeding.
- C. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- D. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
  1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.

2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
  - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- E. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  1. Before building demolition, Owner will remove the following items:
    - a. **<Insert items to be removed by Owner>**.
- F. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  1. Hazardous materials will be removed by Owner before start of the Work.
  2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- G. Hazardous Materials: Present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  3. Owner will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.
- H. On-site storage or sale of removed items or materials is not permitted.

## 1.12 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

### 2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements of Project Geotechnical Report.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. **[Perform] [Engage a professional engineer to perform]** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Inventory and record the condition of items to be removed and salvaged.

#### **3.2 PREPARATION**

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
- B. Salvaged Items: Comply with the following:
  - 1. Clean salvaged items of dirt and demolition debris.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to storage area **[designated by Owner] [indicated on Drawings]**.
  - 5. Protect items from damage during transport and storage.

#### **3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS**

- A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
  - 1. Owner will arrange to shut off utilities when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
  - 4. Cut off pipe or conduit a minimum of **[24 inches]** **<Insert depth>** below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
  - 5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

#### **3.4 PROTECTION**

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of demolition.
- C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
  - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
    - a. Provide at least [72] <Insert number> hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.
  - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
  - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
  - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
  - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
  - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

### 3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings[ and site improvements] completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
  - 2. Maintain fire watch during and for at least <Insert number> hours after flame-cutting operations.
  - 3. Maintain adequate ventilation when using cutting torches.
  - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

### 3.6 DEMOLITION BY MECHANICAL MEANS **Edit this section as required**

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be removed and salvaged are indicated on Drawings.
- D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.
- E. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending **[5 feet]** **<Insert dimension>** outside footprint indicated for new construction. Abandon below-grade construction outside this area.
  1. Remove below-grade construction, including basements, foundation walls, and footings, **[completely]** **[to at least 6 inches below grade]** **[to at least 12 inches below grade]** **[to depths indicated]**.
- F. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
  1. Remove below-grade construction, including basements, foundation walls, and footings, **[completely]** **[to at least 6 inches below grade]** **[to at least 12 inches below grade]** **[to depths indicated]**.
- G. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
- H. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within **[5 feet]** **<Insert dimension>** outside footprint indicated for new construction. Abandon utilities outside this area.
  1. Fill abandoned utility structures with **[satisfactory soil materials]** **[recycled pulverized concrete]** according to backfill requirements in Section 312000 "Earth Moving."
- I. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

- J. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

### 3.7 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations according to backfill requirements in Project Geotechnical Report.
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.
- D. Existing foundation demolition:
  - 1. At any location where a new foundation will overlap an existing foundation
    - a. The soil currently in the existing foundation shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. If foundations are planned to be excavated and completely removed, the geotechnical engineer should be contacted for additional recommendations.
  - 2. At any location where an existing footing/pier does not overlap with a new pier:
    - a. The portion of the existing footing/pier within 1-ft of bottom of new grade beams shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698).
  - 3. While it is common for the testing and inspections laboratory to be involved and on-site during earthwork prep. and operations; (including but not limited to: observing and testing earthwork properties, select fill properties, thicknesses, compaction, moisture content, etc.) We also require the testing and inspections laboratory to be on-site for the infill of any and all demolished foundation items, both partially and fully demolished. We have observed instances where the demo contractor did not properly/adequately infill the sub-grade voids and/or compact the infill from existing demolished foundations. When the new building was constructed, the inadequate fill/compaction led to water intrusion problems and questionable bearing. We require that the testing and inspections laboratory be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved.
    - a. The owner shall be aware that this additional testing inspection scope will be required.
    - b. The general contractor shall inform the demolition contractor(s) that the infill of the demolished foundations will be required to meet the earthwork requirements and be testing for compliance and any additional cost associated with ensuring the infill meets these parameters shall be included in their base bid.

### 3.8 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

### 3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site **[and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.]**

**[and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."]**

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

### **3.10 CLEANING**

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

**END OF SECTION 02 41 16**

## **SECTION 02 41 19 - SELECTIVE STRUCTURE DEMOLITION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
  - 2. Section 01 35 91 "Historic Treatment Procedures" for historic removal and dismantling.
  - 3. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
  - 4. Section 01 56 00 "Temporary Jobsite Protection" for temporary protection of architectural items.
  - 5. Section 01 73 00 "Execution" and 01 73 29 "Cutting and Patching" for cutting and patching procedures.
  - 6. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

#### **1.3 DEFINITIONS**

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged; or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- E. Deconstruct: To remove by disassembling or detaching an item from the surface, using methods and equipment to successfully prevent damage to the item and surfaces; and dispose of items unless indicated as salvaged or for reinstallation.

#### **1.4 QUALIFICATIONS**

- A. Demolition Subcontractor
  - 1. The demolition subcontractor shall meet the following qualification requirements:



- a. The demolition subcontractor company shall have a minimum of five (5) years of demolition and temporary shoring experience of similar size, scale, and complexity of the demolition work involved in this project.
  - b. The site superintendent or foreman shall have the same required experience.
  - c. At a minimum, a demolition subcontractor shall have a representative who has completed OSHA 30 training and be present on site during all demotion and temporary shoring activities.
  - d. Any demolition subcontractors with OSHA violations within the past 5 years or are under active OSHA investigations will not be considered qualified for structural demolition.
2. In cases where the general contractor wishes to employ multiple demolition subcontractors for various demolition scope, all demolition subcontractors shall meet the above qualifications.
- B. Demolition And Temporary Shoring Delegated Design Engineer
1. The structural EOR is not responsible for the design of any temporary shoring or bracing required between demolition and the installation of the new structure. The demolition and temporary shoring delegated design engineer shall be a licensed professional engineer in the state of Texas who specializes in Demolition and temporary structures. The delegated design engineer is responsible for the following:
    - a. Provide a letter stating that they fully understand the scope of work required from all disciplines.
    - b. Shoring plans and demolition plans, which includes sequence of shoring, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
    - c. Excavation support and protection system plans, which includes sequence of support & protection system, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
    - d. Perform periodic site visits which include various milestones for the demolition and shoring subcontractors and shall provide observation report, photos, etc. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed. Measurements shall be taken at milestones.

## 1.5 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

## 1.6 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
  1. Inspect and discuss condition of construction to be selectively demolished.
  2. Review structural load limitations of existing structure.
  3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Review and finalize protection requirements.
  5. Review areas where existing construction is to remain and requires protection.
  6. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  7. Review procedures for noise control and dust control.
  8. Review procedures for protection of adjacent buildings.

9. Review items to be salvaged and returned to Owner.
10. Site walk of all areas of selective demolition activities with the delegated design demolition engineer, structural engineer of record, architect, owner, general contractor, and demolition subcontractor representatives overseeing demolition work in attendance.
  - a. GC shall have removed superficial/architectural coverings so that structure is visible during site walk.

## 1.7 OAC MEETINGS

- A. The General Contractor shall provide a “two-week look ahead” to indicate upcoming areas where demolition work is scheduled to take place, so all parties are aware of timeline and any coordination with architect and consultants can take place. The highlighted plan should be completed by the General Contractor (in conjunction with their demolition subcontractor) and be available for discussion at the weekly OAC meeting.

## 1.8 SUBMITTALS

- A. For Information Only Submittal: Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- B. For Information Only Submittal: Schedule of Selective Demolition Activities: Indicate the following:
  1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
  2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Coordination for shutoff, capping, and continuation of utility services, if any.
  4. Use of elevator and stairs.
  5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
  6. Refer to Section 1.7 for “two-week look ahead” requirement at OAC meetings.
- C. For Information Only Submittal: Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Pre-demolition photographs or videos showing existing conditions for any existing walls or new openings in existing walls, floors, and/or roofs scheduled to be demolished for the structural EOR's review and approval prior to the start of demolition. Photos must show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. The locations of pre-demolition photographs & videos shall be identified on an accompanying plan view.
- E. For Information Only Submittal: Demolition Sub-Contractor(s) qualifications required prior to demolition work commencing. Provide the following documentation:
  1. Demolition Subcontractor Company(s):
    - a. Provide the company's project experience in structural demolition for the past 5 years including the scope of work they performed and references with contact information.
    - b. Disclosure of any OSHA violations within the past 5 years and/or any active OSHA investigations.
    - c. Any company name changes for the past 10 years.
  2. Demolition site superintendent(s) / foreman(s)

- a. Provide the names of the structural demolition site superintendent(s) / foreman(s), their project experience for the past 5 years including the scope of work they performed and references with contact information
  - b. Proof of the individuals' completion of OSHA 30 training.
- F. For Information Only Submittal: Demolition & temporary shoring delegated design engineer letter stating they fully understand the scope of work required from all disciplines.
- G. Delegated-Design Submittal: Shoring plans and demolition plans, which includes sequence of shoring, sequence of demolition, and duration of both signed and sealed by the temporary shoring professional engineer responsible for their preparation.
1. Locations for each shoring and demolition event provided in the sequence of shoring and demolition shall be indicated on the shoring and demolition plan to avoid any confusion as to where these activities should occur.
  2. These plans shall include the general contractors' field verification comments as described in Section 1.10 Field Conditions.
- H. Delegated-Design Submittal: For temporary shoring system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. This shall be submitted with the shoring and demolition plan delegated-design submittal.
1. Provide a plan with temporary shoring system locations, the amount of load the shoring system will see at each location, the type shoring system used at each location, product data showing the load rating for each shoring tower type used on the project.
- I. For Information Only: Observation reports with site photos for periodic site visits at various demolition and shoring milestones prepared by the demolition and temporary shoring delegated design engineer.
1. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed.
  2. Measurements shall be taken at milestones.
- J. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions. Note locations and capping depth of wells and well points.
- K. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

## **1.9 CLOSEOUT SUBMITTALS**

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## **1.10 FIELD CONDITION**

- A. All existing structure shown on the plans are based on limited existing drawings / as-builts of the existing building, in-person site observations, and assumed framing based on the floor plan layout and may not be entirely accurate, complete, or representative of existing conditions. The general contractor shall not demolish any walls, columns, framing, wall openings, floor openings, or roof openings that are not shown and noted to be demolished on the structural demo plans, regardless of if these items are shown to be demolished on the architectural demo plans or any other disciplines' demo plan without structural engineer-of-record (EOR) review & approval. Care

should be taken during demolition to avoid damaging any structural elements that have been designated to remain.

- B. The general contractor shall field verify the location and size of all structural members shown on the plans prior to beginning any demolition work. Gridlines are shown on the structural drawings, and these reflect assumed architectural and structural dimensions. In most cases, grid lines coincide with existing column and pilaster centerlines. If actual field dimensions, or the location and sizes of existing structural members vary, notify the architect, structural EOR, and demolition & temporary structures delegated design engineer. The contractor shall notify the structural EOR of questionable existing structural components (masonry walls, steel beams and lintels, exposed foundations, etc.) and framing connections when encountered. The contractor shall verify that any wall, masonry or otherwise, to be demolished is a non-load bearing wall prior to beginning demolition. If a wall is found to be load bearing, the contractor shall contact the architect and structural EOR before proceeding.
- C. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- D. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  - 1. Before selective demolition, Owner will remove the following items:
- E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

#### **1.11 WARRANTY**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- C. LEED Requirements for Building Reuse:

1. Credit MR 1.1 and Credit MR 1.2: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
3. Credit MR 1.2 and Credit MR 1.3: Maintain existing non-shell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
  2. Steel Tendons, if any: Locate tensioned steel tendons and include recommendations for de-tensioning.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes as appropriate.
  1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

#### **3.2 PREPARATION**

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

### **3.3 SELECTIVE DEMOLITION, GENERAL**

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### **3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS**

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.
  - 1. Foundation at new underground plumbing lines: General contractor shall not core through existing grade beams to install new plumbing lines without review and approval from structural EOR. GC shall submit the following information for structural EOR review for new pipe penetrations in existing grade beams:
    - a. Existing grade beam width, depth, and bottom of grade beam elevation in relation to the FFE for grade beams with new pipe penetrations.
    - b. Existing foundation (piers or spread footing) locations supporting the existing grade beams with new pipe penetrations.
    - c. The planned pipe penetration opening size and the elevation of the center of the new opening in relation to the FFE.
    - d. The planned pipe penetration opening location in relation to the nearest foundation on both sides of the opening.
- D. Existing foundation demolition:
  - 1. At any location where a new foundation will overlap an existing foundation
    - a. The soil currently in the existing foundation shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. If foundations are planned to be excavated and completely removed, the geotechnical engineer should be contacted for additional recommendations.
  - 2. At any location where an existing footing/pier does not overlap with a new pier:
    - a. The portion of the existing footing/pier within 1-ft of bottom of new grade beams shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698).
  - 3. While it is common for the testing and inspections laboratory to be involved and on-site during earthwork prep. and operations; (including but not limited to: observing and testing earthwork properties, select fill properties, thicknesses, compaction, moisture content, etc.) We also require the testing and inspections laboratory to be on-site for the infill of any and all demolished foundation items, both partially and fully demolished. We have observed instances where the demo contractor did not properly/adequately infill the sub-grade voids and/or compact the infill from existing demolished foundations. When the new building was constructed, the inadequate fill/compaction led to water intrusion problems and questionable bearing. We require that the testing and inspections laboratory be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved.
    - a. The owner shall be aware that this additional testing inspection scope will be required.
    - b. The general contractor shall inform the demolition contractor(s) that the infill of the demolished foundations will be required to meet the earthwork requirements and be testing for compliance and any additional cost associated with ensuring the infill meets these parameters shall be included in their base bid.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill unless otherwise directed by Owner.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### **3.6 CLEANING**

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION 02 41 19**



## **SECTION 02 50 00 - SITE RESTORATION**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Restoration of site affected by the Work in public or private property, including pavement, esplanades, sidewalks, driveways, fences, lawns and landscaping.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Payment for restoration of Project site disturbed by utility construction operations is on a linear foot basis. Measurement will be as provided for corresponding utility in each Specification section. No separate payment made for branch pipe, valves and, other associated work for utilities. Measurement for restoration with multiple utilities within the same right-of-way will be on a linear foot basis for only one utility.
  - 2. No separate payment made for facility or roadway projects. Include cost in the surface improvements associated with the facility or roadway construction.
  - 3. Payment includes required site restoration within the right-of-way or easement regardless of size or type of pipe, method of construction, paved or unpaved areas or thickness and width of pavement.
  - 4. No separate payment made for site restoration for service connections under this Section. Include cost in appropriate utility section.
  - 5. Refer to Division 1 for Unit Price procedures.
- B. Stipulated Price (Lump Sum) Contracts. If Contract is Stipulated Price Contract, include payment for work under this section in total Stipulated Price.

#### **1.3 DEFINITIONS**

- A. Phase: Locations identified on the plans and listed in Division 1.
- B. Site Restoration: Replacement or reconstruction of Site Improvements located in rights-of-way, easements, public property, and private property affected or altered by the Work.
- C. Site Improvement: Includes pavement, curbs and gutters, esplanades, sidewalks, driveways, fences, lawns, irrigation systems, landscaping, and other improvements in existence at the Project site before commencement of construction operations.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Schedule of testing, service connections, abandonment, backfill, and site restoration.
- C. Sample of notices to residents outlining their responsibility for maintenance of site improvements adjacent to the Project that are not disturbed by construction operations.

#### **1.5 SCHEDULING**

- A. Schedule testing, service connections, abandonment, backfill and site restoration immediately following completion of pipe laying work or paving within each block or line segment.

- B. Phased Construction:
  - 1. Commencement of subsequent Phase will follow scheduling of site restoration of prior Phase. Limit work to a maximum of two Phases of the project.
- C. Construction of Projects with no Phases listed in Division 1:
  - 1. Complete site restoration prior to disturbing over 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way or easement.
  - 2. Limit work to a maximum of 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way and easement. Commence work in additional right-of-way or easement after completion of site restoration.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Pavement, Sidewalks and Driveways: Materials specified in Division 2.
- B. Seeding and Sodding: Sod specified in Division 2.
- C. Trees, Shrubs and Plantings: Conform to requirements of Division 1.

## **PART 3 EXECUTION**

### **3.1 PREPATORY WORK**

- A. Provide cleanup and restoration crews to work closely behind pipe laying and roadway construction crews, and where necessary, during testing, service restoration, abandonment, backfill and surface restoration.
- B. Water Lines: Unless otherwise approved by Owner's Representative, comply with the following:
  - 1. Once Owner's Representative approves work within a Phase, immediately begin preparatory work for disinfection effort.
  - 2. No later than three days after completing disinfection preparatory work, initiate disinfection work.
  - 3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
- C. Wastewater Lines:
  - 1. Once Owner's Representative approves work within a Line Segment, immediately begin preparatory work for testing effort.
  - 2. No later than three days after completing preparatory work for testing, initiate testing work.
  - 3. Immediately after transfer of service connections, begin abandonment of old wastewater lines, and site restoration.
- D. Street Construction and Paving Projects
  - 1. Once Owner's Representative approves work within a Line Segment or block, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.
3. Immediately after testing begin site restoration.

E. Street Construction and Paving Projects

1. Once Owner's Representative approves work within a block, immediately begin preparatory work for sidewalk construction, sodding and hydromulching and tree planting.
2. No later than seven days after completing preparatory work, initiate construction.

**3.2 CLEANING**

- A. Remove debris and trash to maintain a clean and orderly site in accordance with requirements of General Conditions and Division 1.

**3.3 LANDSCAPING AND FENCES**

A. Seeding and Sodding.

1. Remove construction debris and level area with bank sand so that new grass surface matches level of existing grass and maintains pre-construction drainage patterns. Level and fill minor ruts or depressions caused by construction operations with bank sand, where grass is still viable.
2. Restore previously existing turfed areas with sod and fertilize in accordance with Division 2. Sod to match existing turf.
3. Restore unpaved areas not requiring sodding with hydromulch seeding conforming to Division 2.

B. Trees, Shrubbery and Plants.

1. Remove and replant trees, shrubs, and plants in accordance with requirements of Division 1.

C. Fence Replacement.

1. Replace removed or damaged fencing to equal or better condition than existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing and panels. Metal fencing material, not damaged by the Work, may be reused.
2. Remove and dispose of damaged or substandard material.

**3.4 MAINTENANCE**

- A. Maintain shrubs, plantings, sodded areas and seeded areas.
- B. Replace shrubs, plantings and seeded or sodded areas that fail to become established.
- C. Refer to Division 1 and Division 2 for maintenance requirements.

**END OF SECTION 02 50 00**

## **SECTION 02 82 00 - ASBESTOS REMEDIATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Asbestos material abatement and disposal.
  2. Accessories necessary for complete removal.

#### **1.3 SUBMITTAL**

- A. Submit copy of the signed waste manifests indicating the place, time and exact quantity of asbestos, received by an approved landfill.

#### **1.4 QUALITY ASSURANCE**

- A. Qualifications: Entity having minimum 5 years documented experience, holding required current licenses for the removal, transport, and disposal and related activities relative to the work, having the required personal protective equipment and respirators for abatement operations, with current liability insurance, and who employs workers fully trained and knowledgeable in the removal of hazardous materials.

#### **1.5 STOP ASBESTOS REMOVAL**

- A. If a verbal or written Stop Asbestos Removal Order is given, immediately stop asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM.
  1. Do not resume asbestos removal activity until authorized to do so in writing.
  2. A stop asbestos removal order may be issued at any time it is determined that abatement conditions/activities are not within regulatory requirements or that an imminent hazard exists to human health or the environment.
  3. Work stoppage will continue until conditions have been corrected.

### **PART 2 - MATERIALS**

Not used.

### **PART 3 - EXECUTION**

#### **3.1 REMEDIATION**

- A. The Owner has conducted an asbestos survey and has determined that asbestos may be present in areas where work will be performed. The survey is made available for review.
  1. As part of the work, the Owner requires asbestos removal to be performed under the construction contract.
  2. Asbestos may be present in vinyl tile under architectural woodwork or covered by, but not encapsulated, carpet materials and other types of flooring.
  3. Asbestos may be present in the ductwork above the ceiling panels.
  4. If asbestos is found, stop work in the area and engage an asbestos removal firm to remediate the asbestos from the area. Do not resume work in the affected areas until the

abatement is complete and authorization to proceed with work in the affected areas is given. Work in areas not affected by asbestos may continue.

- B. Assume responsibility and liability for compliance with applicable Federal, State, and Local regulations related to the asbestos abatement work.
  - 1. Provide and maintain training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations.
  - 2. Post required notices prior to the commencement of the work.
  - 3. Restrict access to containment areas to authorized, trained, and protected personnel.
  - 4. Prepare and post an emergency plan in clean room and equipment room of the decontamination unit.
  - 5. Do not permit workers to eat, drink, smoke, chew gum or tobacco, or break the protection of the respiratory protection system in the work area.
- C. Entering and Existing Procedures: Establish procedures for entering and existing containment area. Provide personnel decontamination unkmit with disposable coveralls, head covers, and clean respirators. Provide shower room between personnel decontamination area and equipment room.
- D. Decontamination Procedures: Establish procedures for decontamination upon leaving containment are in accordance with federal and state regulations.
- E. Provide negative pressure filtration systems to complete exchange air 4 time per hour. Provide standby system in the event of a machine failure or emergency.
  - 1. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.
- F. Prepare the Affected Area: Remove furnishings and materials to the extent necessary to remediate the asbestos.
- G. Containment of Areas: Provide a secure containment work area in accordance with federal and state regulations. Avoid damage to existing partitions and ceilings scheduled to remain to the extent possible.
  - 1. Establish critical barriers over each opening into the work area.
  - 2. Close out vents and air ducts to prevent particulates from entering the HVAC system.
- H. Debris: Place contaminated debris in a designated location within the containment area.
  - 1. Place debris in minimum 6 mil poly bags before removing from contaminated areas. Pass Clean or decontaminate bags and pass and pass through a double 6 mil flap doorway into another bag or fiber drum. Remove to disposal dumpster/gondola/vehicle. Do not permit unprotected personnel to come in contact with contaminated bags.
  - 2. Remove and dispose of contaminated debris legally.
- I. Testing: Perform required tests and inspections upon completion of the work. Collect air samples and analyze in accordance with regulations. Upon satisfactory conclusion of testing, remove critical barriers.
- J. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
  - 1. Remove equipment, materials, and debris from the project area.
  - 2. Package and dispose asbestos waste as required.
  - 3. Repair or replace all interior finishes damaged during the abatement work.
  - 4. Fulfill other project closeout requirements as specified elsewhere in this specification.

**3.2 CERTIFICATE OF COMPLETION BY CONTRACTOR**

- A. Submit a signed *Certificate of Completion* at the completion of the abatement and decontamination of the regulated area.

**END OF SECTION 02 82 00**

**SECTION 02 82 13  
ASBESTOS ABATEMENT**

**1.0 SUMMARY OF WORK**

**1.01 DESCRIPTION**

- A. Arnold Middle School scheduled work is to include interior and exterior renovations. Renovations will impact many areas of asbestos containing building materials throughout the Arnold Middle School campus.
- B. The work will include, but is not limited to, the following abatement scope of work in the subject work areas. Reference the abatement floor plans which identifies keyed notes and approximate locations of the abatement scope of work (Abatement Drawing ABT101A-101J).

**Cypress-Fairbanks Independent School District:**

**Arnold Middle School – 11111 Telge Road, Cypress, Texas 77429**

1. Interior Abatement
  - a. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, abate all non-friable, asbestos-containing interior **black damp proofing** coating on CMU block walls, columns and/or beams behind brick and supporting ledges located at new wall openings for doors, building additions and louvers/vent in Areas A, D and H.
  - b. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, abate all non-friable, asbestos-containing **black floor mastic** located under carpet or vinyl flooring in storage closet of Area A.
  - c. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, clean ceiling surfaces and ceilings (including lighting, duct, piping, etc.) of asbestos-containing **plaster/texture dust/debris** located on the ceilings in Areas B, D, E, F, G, H.
  - d. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, abate all friable, asbestos-containing **plaster/texture** located in the corridor of area E, water heater closet of area E, and above doorways and lockers in of area F.
  - e. In locations designated by the General Contractor, abate assumed, asbestos-containing **fire doors**, field verify all fire doors being removed.
  - f. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, abate all non-friable asbestos-containing **sinks** located in Area A and Area H
2. Exterior Abatement
  - a. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, abate all non-friable, asbestos-containing **black damp proofing mastic** coating on CMU block walls, widow/door flashing, columns and/or beams behind brick and supporting ledge. Any associated residual damp proofing mastic around doors, windows, or opening is to be abated and cleaned.

Note: Should additional asbestos containing materials need to be impacted or be discovered during demolition such as **black floor mastic or old pipe insulation**, please notify EFI and CFISD so that the additional scope can be addressed prior to impact.

## 1.02 WORK NOT INCLUDED IN THE WORK PROCEDURES

- A. Replacement of any materials scheduled for removal as part of the Work.
- B. Air monitoring for Owner/Owner's Representative by Testing Laboratory.

## 1.03 EXISTING CONDITIONS

- A. Asbestos Abatement Contractor is advised that the locations of asbestos-containing materials are not clearly known and that it shall proceed with caution in all phases of the Work. Additional asbestos-containing material may be uncovered during the course of the Work and Asbestos Abatement Contractor may be directed by General Contractor to include this material in the Work at an agreed upon price.

## 1.04 BUILDING OCCUPANCY

- A. Owner/Owner's Representative and General Contractor will occupy all other portions of the facility other than the identified work area for the conduct of normal building or construction operations. Coordinate work with Owner/Owner's Representative and General Contractor and conduct activities so as to minimize disruption to the building occupants and to planned building activities.

## 1.05 STORAGE

- A. Limited storage space is available in the building and at the site. Store items only in areas designated by General Contractor. Supply any additional temporary storage areas required for storage of equipment and materials for duration of Project.

## 1.06 CONTRACTOR'S USE OF PREMISES

- A. Coordinate and follow General Contractor's building security/access requirements and sign in/sign out procedures.
- B. Limit use of premises to locations specified by General Contractor.
- C. Predetermine and obtain approval, in advance from General Contractor, for transportation route(s) for contaminated and non-contaminated waste materials, labor and construction materials into and out of the building and site.
- D. If required, coordinate with General Contractor for onsite material delivery/pickup and location of waste disposal container during the Project.
- E. Maintain existing building in a safe condition throughout the Project. Repair damage caused by abatement operations immediately. Take all precautions necessary to protect the building and its occupants during the Project.
- F. Keep work area and associated surrounding areas free from accumulation of waste, rubbish, or construction debris.
- G. Smoking or ignitable devices (e.g. matches, lighters, etc.) will not be permitted within the building or on the premises.
- H. Obtain approval from General Contractor prior to use of existing restroom facilities at the property by the Asbestos Abatement Contractor. Otherwise, Asbestos Abatement Contractor will provide portable toilets for its employees at locations to be approved by General Contractor.



#### 1.07 SCHEDULING AND WORKING HOURS

- A. Contractor's abatement work operations may be performed during or after normal business hours, Monday through Friday, or on the weekends. Submit schedule to General Contractor for approval.
- B. Transportation of construction materials, abatement materials and asbestos waste materials from the work area shall be performed during hours approved by General Contractor.
- C. Obtain approval from General Contractor prior to altering work schedule.

#### 1.08 PARKING

- A. Parking is limited at or near the site. Park only in specified parking areas designated by General Contractor. General Contractor assumes no responsibility for damage or theft to Contractor's vehicles. If necessary, park in offsite parking areas and pay all applicable parking fees.

#### 1.09 BUILDING SECURITY

- A. Coordinate and follow Owner's/Owner's Representative's or General Contractor's building security requirements.
- B. Asbestos Abatement Contractor is responsible for the work area and its own supplies, equipment, and security.
- C. Secure work area completely at the end of each work shift.
- D. Maintain personnel at the asbestos waste disposal container at all times the container is open or not properly secured. Secure container completely at the end of each work shift.
- E. Install viewing windows to allow for observation of the entire work area or as designated by General Contractor or Asbestos Consultant.

#### 1.10 FIRE PREVENTION

- A. Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations, provide type "ABC" dry chemical fire extinguishers, or a combination of several extinguishers per National Fire Protection Association (NFPA) recommendations and OSHA regulations.
- B. Asbestos Abatement Contractor's employees shall not enter building areas with cigarette lighters, matches, cigarettes, cigars, pipes or other flame emitting items. Asbestos Abatement Contractor's employees shall not smoke cigarettes, cigars, pipes or the like within the building areas.
- C. Flammable materials shall not be stored in the work area.

#### 1.11 CONTINGENCY PLAN

- A. Prepare a contingency plan for emergencies including fire, fire alarms, accident, power failure, diminished pressure failure or any other emergency event. Incorporate building's emergency procedures as required. Note that nothing in the Work Procedures should impede safe exiting or providing of adequate medical attention in the event of an emergency.
- B. Post at the entrance to the work area telephone numbers and locations of emergency services including but not limited to the building security office.

#### 1.12 PROJECT SUPERINTENDENT

- A. Maintain a "competent" full-time superintendent (as defined by OSHA, EPA and DSHS) and necessary assistants who shall be in attendance at the facility during the progress of the work. The superintendent shall be satisfactory to General Contractor and shall not be changed without prior approval by the General Contractor.

### 1.13 SEGREGATION OF WORK AREAS

- A. Segregate the work areas from the surrounding occupied or unoccupied areas.
  - 1. Install temporary construction barriers acceptable to General Contractor to segregate work areas and prevent occupant or public access and viewing of the work areas.
  - 2. Install black, frosted or opaque plastic sheeting over windows to prevent public viewing of the work areas.
  - 3. Install secure, temporary plywood barriers in windows, doorways or other openings used for diminished air exhaust. If required, coordinate with General Contractor for the removal of exterior windows/glass.
- B. Demarcate the work area with asbestos warning barrier tape and post asbestos warning signage as required.

### 1.14 PRE-JOB DAMAGE SURVEY OF FACILITY

- A. Perform a thorough survey of work area and the building ingress/egress path prior to starting the Work in order to prepare a list documenting existing damage. Items identified on this list will not be the responsibility of Asbestos Abatement Contractor unless further damaged by Asbestos Abatement Contractor during execution of Project. List shall be provided to General Contractor prior to proceeding with the Work.

### 1.15 CORRECTION OF DAMAGE TO FACILITY

- A. Consider any damage to work area and the building ingress/egress path not identified in the pre-job damage survey as having resulted from execution of the Work and correct, restore, repair and/or replace to General Contractor's satisfaction at no additional expense to General Contractor.

### 1.16 UTILITIES

- A. Asbestos Abatement Contractor may temporarily connect to available existing permanent utilities (e.g. water, sewer and electricity) during execution of the Work. Make connections in locations designated by General Contractor. The cost for the use of existing permanent utilities will be paid by Owner. If permanent utilities are not available, Asbestos Abatement Contractor shall provide and pay for any temporary utilities during the Project. Remove connections and all extensions of utilities at Project completion.

### 1.17 SALVAGEABLE MATERIALS

- A. Consider all materials and items removed in the execution of the Work unsalvageable unless indicated otherwise by the General Contractor.

### 1.18 CLEANUP

- A. Dismantle and dispose of all temporary barriers erected to isolate the work areas at completion of Work.
- B. Leave all areas visibly clean at completion of Work.

## 2.0 SUBMITTALS

### 2.01 DESCRIPTION

- A. Make submittals required by the Work Procedures in a timely manner and at appropriate times in the execution of the Work to allow for sufficient and prompt review by Asbestos Consultant. Revise and resubmit as necessary to establish compliance with the specified requirements.

## 2.02 WORK INCLUDED

- A. Submit complete, bound sets of the submittals required herein. Submit complete sets entitled "Project Submittals".
- B. Update submittals to Asbestos Consultant to account for all new equipment and employees used on the Project.
- C. Project Submittals
  1. Submit one complete set of "Project Submittals" to Asbestos Consultant for review. Bind project submittals in a three-ring binder or cover with metal fasteners.

## 2.03 PROJECT SUBMITTALS

- A. Notice of impending commencement of asbestos removal work, and any amendments if required, in writing via regular mail to:

Environmental Health Notifications Group  
Attention: Asbestos  
Department of State Health Services  
P. O. Box 143538  
Austin, Texas 78714-3538

Or electronically:

Through the Department of State Health Services' Online Asbestos Notification System

and comply with the applicable notice period set forth in EPA 40 CFR 61.145 and Department of State Health Services (DSHS) asbestos regulations. In the case of an emergency and if applicable, contact DSHS and obtain a waiver to the typical notice period. Include one copy of notification and amendments, if applicable, in submittal package. Any required notification fees shall be paid by Asbestos Abatement Contractor.

- B. Copy of the Asbestos Abatement Contractor's license as an Asbestos Abatement Contractor in accordance with the Texas Department of State Health Services asbestos regulations.
- C. Personnel Submittals:
  1. Listing of supervisory personnel (including foremen) and workers to be utilized on the Project. Listing shall be in alphabetical order and include each worker's social security number. Include copy of Texas Department of State Health Services License or Registration for each asbestos supervisor or worker to be used on the Project.
  2. Training documentation that each and every employee to be utilized on the Project has had instruction on the hazards of asbestos exposure, protective dress, use of showers, entry to and exit from work areas and on all aspects of work procedures and protective measures regarding asbestos removal.
  3. Certification from Asbestos Abatement Contractor that each and every worker to be utilized on the Project is actively involved in an employee medical surveillance program for asbestos exposure. Include copy of physician's written opinion for each person to be utilized on the Project.
  4. Individually signed forms by each and every worker to be utilized on the Project, documenting that each is actively involved in a company employee respirator protection program and has had appropriate training in respiratory protection.
  5. Individually signed Certificate of Worker's Release Form for each and every worker to be utilized on the Project.

- D. Properly completed copies of the Uniform Hazardous Waste Manifest (Texas Commission on Environmental Quality form TCEQ-0311, current edition, or EPA equivalent) from the landfill, documenting the disposal of the asbestos-containing/ contaminated waste material.
- E. Copy of the Sign In/Out Logs showing the following: date, name, social security number, entering and leaving time, company or agency represented.

#### **2.04 ASBESTOS CONSULTANT'S REVIEW**

- A. Partial submittals may be rejected for non-compliance with the Work Procedures.
- B. Review by Asbestos Consultant does not relieve Asbestos Abatement Contractor from responsibility for errors which may exist in the submitted data.
- C. Make revisions when required by Asbestos Consultant and resubmit for review.

### **3.0 TESTING LABORATORY SERVICES**

#### **3.01 DESCRIPTION**

- A. Owner/Owner's Representative will provide a qualified Testing Laboratory to perform routine and special testing of the Work under these Work Procedures.
- B. Testing Laboratory representative will, in addition to performing routine and special testing necessary to determine general compliance with the Work Procedures, observe and document, on a daily basis, the execution and progress of the Work. Such observation and documentation shall be for the sole benefit of Owner/Owner's Representative and shall not be construed in any way as to include responsibility for Asbestos Abatement Contractor's means, methods, techniques, sequences or procedures involved with the execution of the Work. Nor shall such observation and documentation by Testing Laboratory be construed as to include responsibility for any safety programs or procedures either utilized or not utilized by Asbestos Abatement Contractor during the Work.
- C. Provision of the Testing Laboratory by Owner/Owner's Representative to perform testing for Owner/Owner's Representative shall not relieve the Asbestos Abatement Contractor from providing its own air testing for compliance with all applicable codes, regulations, requirements and as specified in this Section and elsewhere in the Work Procedures.

#### **3.02 QUALITY ASSURANCE**

- A. All environmental air testing shall be performed in general accordance with the procedures outlined in the National Institute for Occupational Safety and Health (NIOSH) Method No. 7400 and also will follow guidelines issued by the Environmental Protection Agency regarding detection limits.
- B. Final air testing will be performed using Phase Contrast Microscopy (PCM) analysis or Transmission Electron Microscopy (TEM) as specified in this Section and elsewhere in the Work Procedures.
- C. PCM final air samples will be analyzed in general accordance with the sample analysis procedures outlined in NIOSH Method No. 7400.
- D. TEM final air samples will be analyzed in general accordance with the sample analysis procedures outlined in the EPA 40 CFR Appendix A to Subpart E of Part 763 – Interim Transmission Electron Microscopy Analytical Methods.

#### **3.03 PAYMENT FOR TESTING**

- A. Owner/Owner's Representative will pay for all daily environmental air testing and final air clearance testing as required by the Work Procedures.

- B. When additional testing is required due to Asbestos Abatement Contractor non-compliance with the Work Procedures, such testing will be performed by Testing Laboratory and all associated costs will be paid by Asbestos Abatement Contractor.

**3.04 SCHEDULING**

- A. Testing Laboratory will perform tests in areas and at times during the Work as deemed necessary by the Testing Laboratory and as specified in the Work Procedures.
- B. Notify Testing Laboratory of need for final air testing at least 2-4 hours prior to desired time of testing.
- C. Coordinate other scheduling with Testing Laboratory as necessary.

**3.05 SCHEDULE OF AIR SAMPLES**

- A. Before Start of Work:
  - 1. Testing Laboratory will collect, at a minimum, the following air samples to establish a base line before the start of work:

BASE LINE SAMPLES				
Sample Location	Number of Samples	Analysis Method	Minimum Volume (Liters)	Rate LPM
Work Area	3 Minimum	PCM	1250	10 to 16

- 2. Base Line: An action level expressed in fibers per cubic centimeter which, for PCM, is equal to the greater of the average of the samples collected on mixed cellulose ester filters in the work area prior to abatement activities or 0.01 fibers per cubic centimeter.

- B. Daily During the Course of the Work:
  - 1. Testing Laboratory will collect area samples in areas and at times during the work as deemed necessary by the Testing Laboratory, required by the Asbestos Consultant, or as specified in the Work Procedures. Daily samples will be analyzed using Phase Contrast Microscopy.
- C. Final Air Clearance Samples:
  - 1. Testing Laboratory will collect the following air samples to determine if the Asbestos Abatement Contractor may remove the demarcation barriers and demobilize from the site:

FINAL AIR CLEARANCE FOR CONTAINMENT AREAS					
Sample Location	Analysis Method	Number of Samples	Minimum Volume (Liters)	Rate LPM	Results
<b>Non-Friable Materials (Excluding Flooring, floor tile/sheet flooring or floor mastic)</b>					
Inside Work Area	PCM	5 Minimum Per Work Area	1250	10 to 16	<0.01
<b>Friable Materials or Non-Friable Materials that have become Friable in the abatement process. (Including Flooring, floor tile/sheet flooring or floor mastic)</b>					
Inside Work Area	PCM	5 Minimum Per Work Area Less Than or Equal To 1 ARU (160 SQFT or 260LF or 3CF)	1250	10 to 16	<0.01

Inside Work Area	TEM	5 Minimum Per Work Area 3 Blanks (inside, outside and LAB) Greater Than 1 ARU (160 SQFT or 260LF or 3CF)	1300	Up to 10	<70s/mm <sup>2</sup>
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### 3.06 RESULTS

- A. Testing Laboratory will perform all testing and analysis promptly and issue results expeditiously in order to minimize any possible delay in the progress of the Work.
- B. Test results shall be available to General Contractor and Asbestos Abatement Contractor as follows:
  - 1. PCM Air clearance results: within 4 hours following tests.
  - 2. TEM Results deemed necessary by Asbestos Consultant: as quickly as possible but not earlier than 6 hours following completion of tests.
- C. Air tests will be made both inside and outside of work areas, as necessary. Asbestos Abatement Contractor is cautioned, however, that should interpretations be made, opinions be formed and conclusions be drawn as a result of examining the test results, these interpretations, opinions and conclusions will be those made, formed and drawn solely by Asbestos Abatement Contractor. Asbestos Abatement Contractor is responsible for performing air tests required for its evaluation of the safety of its employees.

## 4.0 ASBESTOS ABATEMENT

### 4.01 DESCRIPTION

- A. Perform all planning, administration, execution of work necessary to safely conduct the Work. The Work will consist of the abatement of asbestos-containing materials noted in section 1.01.B.
- B. Approval of or acceptance by Owner/Owner's Representative, General Contractor or Asbestos Consultant of various construction activities or methods proposed by Asbestos Abatement Contractor does not constitute an assumption of liability either by the Owner/Owner's Representative, General Contractor or Asbestos Consultant for inadequacy or adverse consequences of said activities or methods.

### 4.02 DEFINITIONS

- A. The following definitions pertain to the Work of these Work Procedures.
  - 1. **Abatement** - procedures to decrease or eliminate fiber release from precast, spray- or trowel-applied asbestos-containing building materials. Includes encapsulation, enclosure and removal.
  - 2. **ACM** - Asbestos-Containing Material.
  - 3. **Airlock** - system for permitting ingress or egress of personnel without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways at least 3 feet apart.
  - 4. **Air Monitoring** - the process of measuring the fiber content of a specific volume of air during a stated period of time.
  - 5. **Amended Water** - water to which a surfactant has been added.
  - 6. **ANSI** - American National Standards Institute.
  - 7. **ASTM** - American Society for Testing and Materials.

8. **Clean Room** - an uncontaminated area or room which is part of the worker decontamination enclosure system, with provisions for storage of workers' street clothes and protective equipment. Also known as the "Change Room".
9. **Critical Barrier** - Seal applied to openings connecting the abatement area with adjacent spaces that will not be included in the containment. Critical barriers shall not be exposed to the gross removal environment. Examples of openings requiring critical barriers include, but are not limited to: HVAC vents and diffusers; doorways; operable windows; floor, wall, and ceiling penetrations; and air plenums.
10. **Curtained Doorway** - a device to allow ingress or egress from one room to another while minimizing air movement between the rooms. Two curtained doorways spaced a minimum of 3 feet apart form an airlock.
11. **Decontamination Enclosure System** - a series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A worker decontamination enclosure system or an equipment decontamination system always contains at least three airlocks (rooms).
12. **Encapsulation** - the sealing of asbestos surfaces involving application of a material (encapsulant) that will envelop or coat the fiber matrix and eliminate fiber fallout and protect against contact damage.
13. **Enclosure** - procedures necessary to completely enclose material containing asbestos behind airtight, impermeable, permanent barriers.
14. **EPA** - United States Environmental Protection Agency.
15. **Equipment Decontamination Enclosure System** - a decontamination enclosure system for materials and equipment, typically consisting of an airlock, a washroom, and a holding area.
16. **Equipment Room** - a contaminated area or room which is part of the worker decontamination enclosure system, with provisions for storage of contaminated clothing and equipment.
17. **Fixed Object (Immoveable object)** - a unit of equipment or furniture in the work area which cannot be removed from the work area.
18. **Glove-Bag** - A 6 to 12-mil plastic bag fitted with long-sleeved gloves, a tool pouch and an opening for amended water and sealant application.
19. **HEPA Filter** - a High Efficiency Particulate Absolute (HEPA) filter capable of trapping and retaining 99.97 percent of asbestos fibers greater than 0.3 microns in length.
20. **HEPA Vacuum Equipment** - vacuuming equipment equipped with a HEPA-filtration system.
21. **Holding Area** - a chamber between the washroom and uncontaminated area in the equipment decontamination enclosure system. The holding area comprises an airlock.
22. **Moveable Object** - a unit of equipment or furniture in the work area which can be removed from the work area.
23. **MSHA** - Mine Safety and Health Administration.
24. **NEC** - National Electrical Code.
25. **NESHAP** - National Emissions Standard for Hazardous Air Pollutants.
26. **NIOSH** - National Institute for Occupational Safety and Health.
27. **OSHA** - Occupational Safety and Health Administration.

28. **Plastic Sheeting** - plastic sheet material of specified thickness used for protection of walls, floors, etc., and used to seal openings into the work area. All plastic sheeting utilized on the project shall be fire retardant.
29. **PPE** - Personal protective equipment including respirators, disposable clothing, gloves, eye protection, hard hats, safety boots, safety vests, etc.
30. **Removal** - the act of removing asbestos-containing or contaminated materials from the structure under properly controlled conditions to a suitable disposal site.
31. **Shower Room** - a room constituting an airlock, between the clean room and the equipment room in the worker decontamination enclosure system, with hot and cold or warm running water suitably arranged for complete showering during decontamination.
32. **Surfactant** - a chemical wetting agent added to water to improve penetrating ability, thus reducing the quantity of water required to saturate asbestos-containing materials.
33. **Washroom** - a room between the work area and the holding area in the equipment decontamination enclosure system. The washroom comprises an air lock.
34. **Wet Cleaning** - the process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with amended water, disposing of these cleaning tools as asbestos-contaminated waste.
35. **Work Area** - area or areas of Project which undergo abatement or are contaminated.
36. **Worker Decontamination Enclosure System** - a decontamination enclosure system for workers, typically consisting of a clean room, a curtained doorway or airlock, a shower room, a curtained doorway or airlock, and an equipment room.

#### 4.03 REFERENCE STANDARDS

- A. Acknowledge awareness and familiarity with the contents and requirements of the following regulations, codes, standards, and guidance documents. Assume responsibility for the performance of the Work in strict compliance with these documents and for every instance of failure to comply with these documents. The current issue of each document shall govern. Where conflict exists between these documents and the Work Procedures, the more stringent requirements shall apply.
  1. EPA Regulations for Asbestos (40 CFR 61.140 - 61.157 and 40 CFR 763).
  2. OSHA Asbestos Regulations (29 CFR 1910, 29 CFR 1926).
  3. EPA Office of Toxic Substances Guidance Document, "Asbestos-Containing Materials in School Buildings", Part I and Part II.
  4. EPA Office of Pesticide and Toxic Substances Guidance Document, "Guidance for Controlling Friable Asbestos-Containing Materials in Buildings", EPA 560/5-85-024, June, 1985.
  5. All state, county, and city codes and ordinances as applicable. Make available for review at the site one copy of EPA, OSHA, and applicable state, county and city regulations governing the Work.

#### 4.04 WORKSITE CONDITIONS

- A. Worker and Visitor Procedures: Asbestos Abatement Contractor is hereby advised that asbestos has been determined by the U.S. Government to be a CANCER-CAUSING AGENT. Provide workers and visitors with respirators (which, as a minimum, meet the



requirements of OSHA 29 CFR 1926.1101) and protective clothing during all phases of the Work and until final air tests are accepted by Asbestos Consultant.

- B. Airborne Fiber Concentration - Inside Work Area: Testing Laboratory will conduct prevalent levels prior to abatement operations, and daily air monitoring inside the work area to monitor the effectiveness of Asbestos Abatement Contractor's work practices during removal activities. The Testing Laboratory will provide the General Contractor a daily copy of the sample results. The following fiber concentrations will be based on environmental air samples obtained in the work area:
1. Maintain an average airborne fiber concentration inside the work area of less than or equal to prevalent level or 0.05 fibers per cubic centimeter (f/cc), whichever is greater. If the average daily fiber counts obtained from the work area rise above this figure, revise work procedures to lower the fiber counts.
  2. Upon notification by the Testing Laboratory that the average airborne fiber concentrations exceed 0.1 fibers per cubic centimeter for any period of time, cease work and commence cleaning of the Work Area. Work activities may not resume until Testing Laboratory performs testing to obtain a fiber concentration less than or equal to prevalent level or 0.05 fibers per cubic centimeter, whichever is greater.
- C. Airborne Fiber Concentration - Outside Work Area: Testing Laboratory will conduct prevalent levels prior to abatement operations, and daily air monitoring outside the Work Area to monitor the effectiveness of Asbestos Abatement Contractor's work practices and work area enclosure during removal activities. The Testing Laboratory will provide the General Contractor a daily copy of the sample results. The following fiber concentrations will be based on environmental air samples obtained outside the work area:
1. Maintain an airborne fiber concentration outside the work area less than or equal to prevalent level or 0.01 fibers per cubic centimeter (f/cc), whichever is greater. Upon notification by the Testing Laboratory, that the airborne fiber concentration exceeds this level, commence cleaning of the affected area. Continue cleaning until Testing Laboratory performs testing to obtain a fiber concentration less than or equal to prevalent level or 0.01 fibers per cubic centimeter, whichever is greater.
  2. Upon notification by the Testing Laboratory, that an airborne fiber concentration obtained outside the work area exceeds 0.05 fibers per cubic centimeter, cease work, restrict access into the affected area with the installation of barrier tape, and commence cleaning of the affected area. Review work procedures and work area enclosure for effectiveness, and review activities in the general location of the affected area for potential of creating airborne fibers. Report review findings to General Contractor and Asbestos Consultant. Continue cleaning until Testing Laboratory performs testing to obtain a fiber concentration less than or equal to prevalent level or 0.01 fibers per cubic centimeter, whichever is greater. General Contractor may elect to perform additional testing at Asbestos Abatement Contractor's expense.

#### 4.05 PERSONNEL PROTECTION

- A. Prior to commencement of work, instruct all workers in the appropriate procedures for personnel protection and asbestos removal. Ensure that workers are knowledgeable in these procedures.
- B. Provide respiratory protection at all times, which is in compliance with OSHA requirements. When not in violation of the above, the minimum acceptable respiratory protection used for this project shall be as follows, unless airborne fiber concentrations inside the face mask exceed 0.01 fibers per cubic centimeter (f/cc). In the event that airborne fiber concentrations inside the mask exceed 0.01 f/cc, respiratory protection required to achieve 0.01 f/cc shall be used.

1. Provide a minimum of half-face dual cartridge respirators for workers during pre-cleaning of work area (including HEPA-vacuuming of floors), installation of plastic sheeting, and waste handling and disposal activities outside the work area.
  2. Provide a minimum of Powered Air Purifying Respirator (PAPR) equipment for "friable" removal work and half-face respirators for "non-friable" removal work for workers during all phases of the Work from the time of first disturbance of the asbestos-containing/contaminated material until acceptance of final air clearance tests by Asbestos Consultant.
  3. Provide additional "piggy-back" cartridges recommended by the product or solvent manufacturer whenever solvents (e.g. mastic removers, spray adhesives, etc.) are used.
- C. Be solely responsible for scheduling necessary air sampling by an independent testing laboratory for compliance monitoring of own respiratory protection with OSHA regulations. Pay for all costs associated with such testing. In addition, submit copies of personal air monitoring results to Asbestos Consultant. If a prior negative exposure assessment (NEA) is used in lieu of employee air monitoring, provide documentation indicating that an NEA has been performed and include supporting documentation (e.g. the objective data used in the determination of the NEA).
- D. Permit no visitors, except for governmental inspectors having jurisdiction, or as authorized by General Contractor or Asbestos Consultant, in the work areas after commencement of asbestos disturbance or removal.
- E. Provide workers sufficient sets of protective disposable clothing, consisting of full-body coveralls, head covers, gloves, and foot covers, of sizes to properly fit individual workers.
- F. Leave reusable equipment, apparel and protection devices (excluding respirators) in the work area until the end of the asbestos abatement work, at which time such items shall be disposed of as contaminated waste or decontaminated for reuse.
- G. Provide suitable respirators and protective disposable clothing for use by authorized visitors, Owner/Owner's Representative, General Contractor, Asbestos Consultant and Testing Laboratory's representatives. Furnish these in as many sets as required for full-time monitoring by Testing Laboratory.
- H. Provide and post at the entrance to the work area the asbestos removal work procedures to be followed by workers.

#### 4.06 OBSERVATIONS

- A. Asbestos Consultant will observe the status and progress of the Work for completeness and general compliance with the requirements of the Work Procedures. At a minimum, the observations will be conducted at the following times during the Project:
1. During preparation of work areas.
  2. Following complete preparation of work areas and prior to proceeding with actual disturbance of asbestos-containing material.
  3. During removal of asbestos-containing material.
  4. At designated times during the cleaning phases.
  5. As appropriate during the work outlined elsewhere in the Work Procedures.

#### 4.07 SIGN-IN/OUT LOG

- A. Maintain a Sign-In/Out Log in the immediate vicinity of the entrance to the work area. Maintain log from the time the first activity is performed involving the disturbance of asbestos-containing material until acceptance of the final air test results by Asbestos Consultant.

Require all persons entering the work areas, including the Asbestos Abatement Contractor's workers, Asbestos Consultant, General Contractor, Owner/Owner's Representative or agents of the Owner/Owner's Representative, government officials to register each time upon entering and leaving work areas. Indicate name, last four numbers of the social security number, time, company, or agency represented and reason for entering work area.

#### 4.08 MATERIALS

- A. **Glove-Bag** - Six-mil or greater thickness, in size sufficient to allow airtight seal around pipe. Separate tool pouch and openings for amended water or sealant and HEPA-vacuum must be present.
- B. **Impermeable Containers** - suitable to receive and retain asbestos-containing or contaminated materials until disposal at an approved site and labeled in accordance with OSHA Regulation 29CFR 1926.1101. Containers shall be both air and water tight.
- C. **Mastic Remover** - Manufactured by a reputable, established manufacturer of mastic (adhesive) remover materials and approved specifically for use in asbestos-contaminated environments. Provide product compatibility for usage in confined areas. Flash Point shall be greater than 140 degrees Fahrenheit as determined by ASTM D 92. Product waste shall not meet the definition of hazardous waste under the EPA hazardous waste regulations 40CFR 261.
- D. **Plastic Sheeting** - thicknesses as specified, in sizes to minimize the frequency of joints. All plastic sheeting utilized on the project shall be fire retardant.
- E. **Sealant (encapsulant)** - manufactured by reputable, established manufacturer of encapsulant/sealant materials and approved specifically for use in asbestos-contaminated environments. Determine compatibility of the sealant with the materials and conditions.
- F. **Surfactant (wetting agent)** - mixture of "Dust-Set Amended Water Base" (Matheson Chemical Corporation) or equivalent and water, mixed to manufacturer's specifications.
- G. **Tape** - glass fiber or other type capable of sealing joints of adjacent sheets of plastic and for attachment of plastic sheet to finished or unfinished surfaces under both dry and wet conditions.
- H. **TSP Cleaning Solution** - Trisodium phosphate cleaning solution, such as Sentinel 805 (Sentinel Chemical Company) or equivalent and water, mixed to manufacturer's specifications.
- I. **Warning Labels and Signs** - as required by OSHA 29CFR 1926.1101.
- J. **Other Materials** - provide all other materials, such as lumber, nails and hardware, which may be required to construct and dismantle the decontamination system and the barriers that isolate the work area.

#### 4.09 TOOLS AND EQUIPMENT

- A. Provide suitable tools for asbestos-containing material removal.
  - 1. **Air Purifying Equipment (for internal recirculation in the work area)** - HEPA Filtration Systems or Electronic Precipitators. Verify that no internal air movement system or purification equipment exhausts contaminated air from inside the work area into uncontaminated areas.
  - 2. **Half-Face Respirator Equipment** - negative pressure, half-face air purifying respirators approved by NIOSH and MSHA for asbestos removal work.
  - 3. **HEPA-Filtered Vacuum** - vacuum equipped with a HEPA filtration system.
  - 4. **Powered Air Purifying Respirator (PAPR) Equipment** - powered air purifying respirators (PAPRs) approved by NIOSH and MSHA for asbestos removal work.

5. **Scrapers and Brushes** - as required to remove asbestos-containing materials.
6. **Transportation** - as required for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons or property. Use only enclosed trucks or dumpsters to haul waste containers to prevent loss or damage of containers in route to the landfill.
7. **Water Sprayer** - utilize airless or other low pressure sprayer for amended water application.

#### 4.10 PREPARATION

- A. Coordinate with General Contractor for HVAC system supplying work area to remain off during all abatement activities. Alternatively, completely isolate HVAC system from the work area containment.
- B. Coordinate with General Contractor to identify, isolate and “make safe” all electrical, wiring, cabling, life safety, telephone/data/communication, etc. to be left in place. Clearly identify and mark all active systems or components to remain and protect from damage.
- C. Coordinate with General Contractor to remove movable objects from the work area as necessary to access asbestos-containing materials.
- D. Initial Work Area Preparation
  1. Erect temporary construction barriers and/or dust barriers as required to prevent building occupant or public viewing of the construction area.
  2. Install and entry vestibule or “airlock” at the entry of the construction area.
  3. Install construction warning tape and signs outside the construction area to prevent building occupant or public access to the construction area.
  4. Install asbestos warning barrier tape and signs inside the construction areas to segregate and demarcate the abatement work area within the construction area.
  5. Flammable materials (e.g. plastic sheeting, spray adhesives, etc.) shall not be stored in the work area.
  6. Maintain a Sign In/Out Log in the immediate area of the entrance to the work area to be utilized by every person, each time upon entering and leaving the work area.
- E. Preparation of Work Area Enclosure for the Removal of Friable – Texture / Plaster from concrete decking – Full Containment.
  1. Coordinate with Owner/General Contractor for HVAC inside or supplying work area to remain off during all abatement activities.
  2. Install critical barriers and seal all openings and equipment within work area with a minimum of two layers of 6-mil (true thickness) plastic sheeting. Where fire hazards exists install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  3. Notify Asbestos Consultant for observation of the critical barriers prior to pre-cleaning work area.
  4. Wet clean and HEPA-vacuum all immovable objects, equipment, walls and floor in the work area
  5. Install two layers of 6-mil plastic sheeting (true thickness) on the floor below extending up the walls 18-inches with a minimum 12-inch to overlap between layers of plastic sheeting.

6. Install minimum two layers of 4-mil plastic sheeting (true thickness) on the entire height of the walls overlapping the floor sheeting and running from floor to ceiling and/or decking. If there is no wall on a side of the enclosure area, install two layers of 6-mil plastic sheeting as a critical barrier and then one layer of 4 mil plastic sheeting over the critical barrier for a total of 3 layers. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  7. In areas where the Mechanical, Electrical/Technology and Plumbing are to stay intact in ceiling plenum areas, HEPA vacuum and wet wipe around all HVAC and electrical equipment, piping and insulations, light fixtures, etc. and then install a minimum two layers of 6-mil plastic sheeting (true thickness) around everything to stay. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  8. Construct a three-stage worker/equipment decontamination unit consisting of an airlock, shower, and a clean room. Construct decontamination unit of appropriate materials (including plastic sheeting) to provide airtight barriers and allow continuous diminished pressure to be maintained in work areas. Provide proper decontamination equipment (water sprayer, towels, etc.) in the airlock to allow workers to properly decontaminate prior to exiting the airlock or removing materials from the work area. Post OSHA decontamination procedures in Change Room for duration of Project.
  9. Place each work area under diminished air pressure utilizing HEPA filtration systems which comply with ANSI Z9.2-79, local exhaust ventilation.
  10. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.
- F. Preparation of Work Area Enclosure for the Removal of Interior Black Damp Proofing on CMU Block – Full Containment.
1. Coordinate with Owner/General Contractor for HVAC inside or supplying work area to remain off during all abatement activities.
  2. Install critical barriers and seal all openings and equipment within work area with a minimum of two layers of 6-mil (true thickness) plastic sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  3. Notify Asbestos Consultant for observation of the critical barriers prior to pre-cleaning work area.
  4. Wet clean and HEPA-vacuum all immovable objects, equipment, walls and floor in the work area
  5. Install minimum one layer of 4-mil plastic sheeting (true thickness) the entire height of the walls from floor to ceiling/decking. If there is no wall on a side of the enclosure area, install two layers of 6-mil plastic sheeting as a critical barrier. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  6. Install two layers of 6-mil plastic sheeting (true thickness) on the floor below extending up the walls 18-inches with a minimum 12-inch to overlap between layers of plastic sheeting.
  7. Ceiling preparation, install one layer of 4-mil (true thickness) plastic sheeting to extend the wall sheeting up and over the work area to provide a complete, segregated work area enclosure. If ceilings do not exist, install two layers of 4-mil (true thickness) plastic sheeting to extend the wall sheeting up and over the work area to provide a complete, segregated work area enclosure. Provide at least 18 inches of overlap with

- wall sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
8. Construct a three-stage worker/equipment decontamination unit consisting of an airlock, shower, and a clean room. Construct decontamination unit of appropriate materials (including plastic sheeting) to provide airtight barriers and allow continuous diminished pressure to be maintained in work areas. Provide proper decontamination equipment (water sprayer, towels, etc.) in the airlock to allow workers to properly decontaminate prior to exiting the airlock or removing materials from the work area. Post OSHA decontamination procedures in Change Room for duration of Project.
  9. Place each work area under diminished air pressure utilizing HEPA filtration systems which comply with ANSI Z9.2-79, local exhaust ventilation.
  10. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.
- G. Preparation of Work Area for the Removal of Dust and Debris above Ceilings via HEPA Vacuuming and Wet Wiping Methods
1. Coordinate with Owner/General Contractor for HVAC inside or supplying work area to remain off during all abatement activities.
  2. Install asbestos warning barrier tape and signs inside the construction areas to segregate and demarcate the abatement work area within the construction area.
  3. Install of two layers of 6-mil (true thickness) plastic sheeting on the floor below the work area extending 6 feet in either direction of the work area to act a drop cloth.
  4. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.
- H. Preparation of Work Area for Glove-Bag Area Removal of Pipe Insulation and/or Duct Insulation.
1. Coordinate with Owner/General Contractor for HVAC inside or supplying work area to remain off during all abatement activities.
  2. Install two layers 6-mil (true thickness) plastic sheeting on floor below work area extending at least 3 feet beyond the glove-bag in each direction.
  3. Check pipe along entire length for damaged insulation. If damaged insulation is found, wrap the area with one layer of 6-mil plastic sheeting and seal with duct tape during the removal. If a large portion of the insulation is damaged wrap the entire length in one layer, 6-mil plastic sheeting and seal with duct tape.
  4. Place all necessary tools for removal in glove-bag before attaching to pipe.
  5. Place at least one layer of duct tape around the pipe at each location where the glove-bag will be attached to ensure an airtight seal. Secure glove-bag to pipe with sufficient duct tape to ensure the bag does not pull loose during removal.
  6. Attach the HEPA-vacuum unit to the glove-bag to provide a negative pressure in the bag.
  7. In the presence of Asbestos Consultant, smoke test the glove-bag. If a leak is detected, reseal and retest bag. Turn on the HEPA-vacuum to clear the smoke and further test the seal.
  8. Provide a remote two stage decontamination unit with air locks, use "double-suit" decontamination procedures as follow:

- a. Two sets of protective disposable clothing will be worn while performing the work.
  - b. HEPA-vacuum and remove the outer set of protective clothing near the work area, immediately before entering the airlock.
  - c. Once in the airlock, wet clean or HEPA-vacuum respirator and exposed portions of the body. Then HEPA-vacuum and remove inner set of protective clothing prior to leaving the airlock.
  - d. Maintain respiratory protection throughout the decontamination process. Dispose of all used protective clothing and disposable filter cartridges as asbestos-contaminated waste.
- I. Preparation of Work Area Enclosure for the Removal Floor Tile, Floor Sheeting and Floor Mastics.
1. Coordinate with Owner/General Contractor for HVAC inside or supplying work area to remain off during all abatement activities.
  2. Install critical barriers and seal all openings and equipment within work area with a minimum of two layers of 6-mil (true thickness) plastic sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  3. Notify Asbestos Consultant for observation of the critical barriers prior to pre-cleaning work area.
  4. Wet clean and HEPA-vacuum all immovable objects, equipment, walls and floor in the work area
  5. Install one layer of 4-mil (true thickness) entire height of wall from floor to ceiling. If there is no wall on a side of the enclosure area, install two layers of 6-mil plastic sheeting as a critical barrier. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  6. Ceiling preparation: (if hard ceilings exist, ceiling prep is not required)
    - a. Option 1 - Should the ceiling not be intact, install two layers of 4-mil (true thickness) plastic sheeting to extend the wall sheeting up and over the work area to provide a complete, segregated work area enclosure. Provide at least 18 inches of overlap with wall sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
    - b. Option 2 - Should the ceiling be intact, but the walls around the containment work area are not demising, install one layer of 4-mil (true thickness) plastic sheeting to extend the wall sheeting up and over the work area to provide a complete, segregated work area enclosure. Provide at least 18 inches of overlap with wall sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  7. Construct a three-stage worker/equipment decontamination unit consisting of an airlock, shower, and a clean room. Construct decontamination unit of appropriate materials (including plastic sheeting) to provide airtight barriers and allow continuous diminished pressure to be maintained in work areas. Provide proper decontamination equipment (water sprayer, towels, etc.) in the airlock to allow workers to properly decontaminate prior to exiting the airlock or removing materials from the work area. Post OSHA decontamination procedures in Change Room for duration of Project.

8. Place each work area under diminished air pressure utilizing HEPA filtration systems which comply with ANSI Z9.2-79, local exhaust ventilation. Ensure that odors from solvents to be used do not permeate to other occupied or public areas of the facility.
  9. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.
- J. Preparation of Work Area for Removal of Sinks (Component Removal).
1. Install barrier tape around the work area.
  2. Install two layers of 6-mil plastic sheeting (true thickness) on the floor below the areas where the removal is to occur to act as a drop cloth.
  3. Use decontamination procedures, as described here, for personnel in work area.
    - a. Two sets of protective disposable clothing will be work while in work area.
    - b. Remove the outer set of protective clothing and HEPA-vacuum and remove the inner suit inside the work area, immediately before leaving the work area.
    - c. Dispose of all used protective clothing as asbestos-contaminated waste.
  4. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.
- K. Preparation of Work Area for Removal of Exterior Wall Damp Proofing (NESHAP).
1. Coordinate with Owner/General Contractor for HVAC inside or supplying work area to remain off during all abatement activities.
  2. Install construction barrier tape.
  3. If removal of damp proofing creates an opening to the interior of building areas, install a minimum of two layers of 6-mil (true thickness) plastic sheeting as critical barriers and seal all openings on the interior side of the building in the location where the damp proofing will be removed. In areas where the opening will be very large and there are no walls to support the plastic sheeting critical, install framing supports as needed to support the plastic sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above.
  4. Install two layers 6-mil (true thickness) plastic sheeting on floor below the work area.
  5. Use decontamination procedures, as described here, for personnel in work area.
    - a. Two sets of protective disposable clothing will be work while in work area.
    - b. Remove the outer set of protective clothing inside the work area, immediately before entering the airlock.
    - c. HEPA-vacuum and remove the inner suit prior to leaving the airlock.
    - d. Dispose of all used protective clothing as asbestos-contaminated waste.
  6. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.

#### 4.11 REMOVAL OF ASBESTOS-CONTAINING MATERIAL

- A. Remove and properly dispose of all asbestos-containing materials scheduled for removal in the Work Procedures in accordance with the methods and procedures outlined in the OSHA 29CFR 1926.1101 and as more stringently specified herein.
- B. Removal of Texture / Plaster from concrete decking.
  1. Prepare work area as described in Item 4.10E.



2. As necessary, perform secondary preparation in ceiling plenum areas to install critical barriers and maintain isolated work area. Critical barriers shall consist of two layers of 6-mil (true thickness) plastic sheeting over exposed openings (e.g. pipe chases, wall cavities, tops of walls, etc.).
  3. Spray areas of asbestos-containing material with amended water using spray equipment capable of providing a "mist" application to reduce the release of fibers. Spray the asbestos-containing material repeatedly during work process to maintain wet condition but do not use excessive amounts of water.
  4. Remove and dispose of limited amounts of gypsum board, lath/plaster or acoustical ceilings as necessary to complete secondary preparation in ceiling plenum areas. Dispose as asbestos-contaminated waste.
  5. Notify Asbestos Consultant for observation of the completion of secondary preparation prior to proceeding with "above ceiling" demolition.
  6. As necessary to access asbestos-containing materials, lower HVAC sheet metal ductwork. Seal all exposed HVAC sheet metal ductwork and ductwork openings, with a critical barrier consisting of a minimum of two layers of 6-mil (true thickness) plastic sheeting. Prior to installation of critical barriers, wet clean and HEPA-vacuum surfaces to be protected, including inside of the ductwork remaining in the work areas.
  7. Remove and dispose of all remaining "above ceiling" demolition items. Dispose as asbestos-contaminated waste.
  8. After removal of asbestos-containing material, wet-clean and HEPA-vacuum all surfaces in the work area to remove residual accumulated material. Continue wet-cleaning until surfaces are visibly free of material.
  9. Notify Asbestos Consultant for observation of the completion of cleaning.
- C. Removal of Interior Black Damp Proofing on CMU Block – Full Containment.
1. Prepare work area as described in Item 4.10F.
  2. Spray areas of asbestos-containing material with amended water using spray equipment capable of providing a "mist" application to reduce the release of fibers. Spray the asbestos-containing material repeatedly during work process to maintain wet condition but do not use excessive amounts of water.
  3. As necessary, remove the asbestos-containing material. As the material is removed, place the material in a properly labeled sealable plastic bag of 6-mil minimum thickness, and remove from work area.
  4. After removal of asbestos-containing material, wet-clean and HEPA-vacuum all surfaces in the work area to remove residual accumulated material. Continue wet-cleaning until surfaces are visibly free of material.
  5. Notify Asbestos Consultant for observation of the completion of cleaning.
- D. Removal of Dust and Debris above Ceilings via HEPA Vacuuming and Wet Wiping Methods
1. Prepare work area as described in Item 4.10G.
  2. **Do not use excessive amounts of water.** Spray areas of asbestos-containing material with amended water using spray equipment capable of providing a "mist" application to reduce the release of fibers. Spray the asbestos-containing material dust/debris repeatedly during work process to maintain wet conditions.
  3. After removal of asbestos-containing material, HEPA-vacuum and wet-clean all surfaces in the work area to remove residual accumulated material or clean adjacent surfaces as required. Continue wet-cleaning until surfaces are visibly free of material.

4. Notify Asbestos Consultant for observation of the completion of cleaning.
- E. Removal of Pipe Insulation and/or Duct Insulation and Mastic – Glovebag.
1. Prepare work area as described in Item 4.10H.
  2. Insert the water sprayer wand and tape all the water sleeve tightly around the wands to prevent air leakage.
  3. Use two people for glove-bag operation. One to remove insulation, the other to operate water sprayer and repair any leaks in bag.
  4. At all times, keep insulation thoroughly wetted.
  5. Care shall be taken not to puncture bag while cutting insulation.
  6. Gently remove insulation from pipe and place it in bottom of bag.
  7. After removal of insulation, brush, and wet-clean pipe to remove residual material. Continue wet cleaning until surfaces are free of visible material.
  8. Spray all tools with water inside bag and place back in pouch.
  9. Wet and double seal with plastic sheeting and duct tape, visible ends of remaining pipe insulation.
  10. Spray the inside of the bag with amended water and remove the watering wand, taping the water sleeve closed.
  11. Using the HEPA-vacuum, collapse bag and seal off lower portion containing asbestos-containing material and gloves of the bag.
  12. Remove bag from pipe, HEPA-vacuum from bag and tools from pouch.
  13. Encapsulate abated section of pipe and any adjacent pipe which did not contain insulation.
- F. Removal of Floor Tile, Floor Sheeting and Floor Mastics.
1. Prepare work area as described in Item 4.10I.
  2. Spray areas of asbestos-containing material with amended water using spray equipment capable of providing a "mist" application to reduce the release of fibers. Spray the asbestos-containing material repeatedly during work process to maintain wet condition but do not use excessive amounts of water.
  3. Remove floor tile or floor sheeting. As it is removed, place the material in a properly labeled sealable plastic bag of 6-mil minimum thickness, and remove from work area.
  4. As necessary, apply mastic remover to dissolve the mastic used to adhere the floor tile or floor sheeting to the concrete slab. The mastic remover is to be used per the manufacturer's recommendations.
  5. After removal of asbestos-containing material, wet-clean and HEPA-vacuum all surfaces in the work area to remove residual accumulated material. Continue wet-cleaning until surfaces are visibly free of material.
  6. Notify Asbestos Consultant for observation of the completion of cleaning.
- G. Removal of Sinks (Component Removal).
1. Prepare work area as described in Item 4.10J.
  2. Remove the component without disturbance or breaking, wrapped and seal the component in two layers of 6-mil (true thickness) plastic sheeting and properly labeled.

3. Notify Asbestos Consultant for observation of the completion of removal.
- H. Removal of Exterior Wall Damp Proofing.
1. Prepare work area as described in Item 4.10K.
  2. Remove damp proofing from substrate along with any adhesive materials utilized, if present and place materials in properly labeled sealable plastic bags of 6-mil minimum thickness and dispose of. Any material that cannot be placed in 6-mil plastic bags shall be wrapped and sealed in two layers of 6-mil (true thickness) plastic sheeting and properly labeled.
  3. Notify Asbestos Consultant for observation of the completion of removal.

#### 4.12 CLEANUP AND CLEARANCE TESTING

- A. Provide general cleanup of work area concurrent with the removal of all asbestos-containing materials. Do not permit accumulation of debris on workspace floor.
- B. Cleanup Sequence
1. Remove all visible accumulations of asbestos-containing material and debris.
  2. Carefully remove plastic sheeting on the walls or floor. Maintain plastic seals (i.e. critical barriers) on entrances, wall/floor penetrations, etc. Plastic sheeting must be double bagged in appropriately labeled 6-mil (true thickness) plastic bags.
  3. Wet clean and HEPA-vacuum any remaining debris.
  4. Notify Asbestos Consultant for observation of cleaning to determine completeness. Work area surfaces will be considered clean when free from dust, dirt, residue, or film resultant from abatement operations or other activities subordinate to these operations.
- C. Final Air Clearance Testing
1. Testing Laboratory will conduct clearance testing of the work area as described in section 3.05C after the Asbestos Consultant has determined the work area is clean.
  2. Glovebag Removal - Testing Laboratory will collect air samples in the work area during the removal and cleaning operations. If these samples indicate airborne fiber concentrations of less than or equal to ambient prevalent levels or 0.01 f/cc, whichever is greater, the work will be considered completed.
  3. PCM Clearances - Testing Laboratory will test for the final air clearance levels upon notice from Asbestos Abatement Contractor that work areas are considered by Asbestos Consultant as visually decontaminated. If the final air clearance samples indicate airborne fiber concentrations of less than or equal to ambient prevalent levels or 0.01 f/cc, whichever is greater, the work will be considered completed.
  4. TEM Clearances - Testing Laboratory will test for the final air clearance levels upon notice from Asbestos Abatement Contractor that work areas are considered by Asbestos Consultant as visually decontaminated. If the final air clearance samples indicate airborne fiber concentrations of less than 70 structures per millimeters squared (s/mm<sup>2</sup>), the work will be considered completed.
  5. Re-clean and continue to clean at Asbestos Abatement Contractor's expense, areas which do not comply with the specified final clearance level. Asbestos Abatement Contractor to bear cost of all follow-up tests necessitated by the failure of the air tests to meet the specified clearance level.
  6. Upon achieving final air clearance, dismantle the work area barriers and signage.

#### 4.13 DISPOSAL OF ASBESTOS-CONTAMINATED WASTE

- A. Perform bag decontamination procedures as follows:
1. As bags are moved out of the work area, wet-wipe bags to remove all contamination from them before they are moved into an uncontaminated space.
  2. Place bagged waste into appropriately labeled second bag for transport to landfill.
  3. Label asbestos-containing/contaminated waste in accordance with EPA 40 CFR 61.150, including waste generator and location information.
  4. Transport bagged waste on-site inside an enclosed buggy. Enclose and secure top of buggy with a minimum of 6-mil opaque plastic sheeting.
- B. Transportation to landfill shall be performed in accordance with all federal, state, and local laws and regulations.
1. Place bags in the lockable, fully enclosed, metal waste disposal container, which has been lined with a minimum of one layer of 6-mil plastic sheeting. Plastic sheeting for the transport shall be reinforced type.
  2. Transport contaminated waste using a transporter licensed by the Texas Department of State Health Services to transport asbestos waste.
  3. Provide Texas Commission on Environmental Quality manifests (or EPA equivalent) for transportation of all contaminated waste to landfill.
- C. Remove sealed and labeled bags of contaminated material and wastes, and transport them for disposal to an approved landfill as follows:
1. Notify Asbestos Consultant prior to removing each waste disposal container from the jobsite.
  2. Dispose of treated, packaged, labeled, asbestos-containing waste material in accordance with EPA 40 CFR 61.150.
  3. Allow only sealed plastic bags or impermeable containers to be deposited in landfill.
  4. Ensure that there are no visible emissions to the outside air from site where materials and waste are deposited.
  5. Submit copies of receipts from authorized representative of landfill operator for each delivery of waste material to Asbestos Consultant after each delivery and a complete set of copies of receipts for all deliveries.

#### 4.14 SCHEDULING

- A. Asbestos Consultant will perform observations in areas and at times during the Work as deemed necessary by the Asbestos Consultant and as specified in the Work Procedures.
- B. Coordinate scheduling of observations with Asbestos Consultant as necessary. Should advance notice not be given to Asbestos Consultant, Asbestos Consultant will make reasonable effort to comply with time of requested observations. Do not proceed until such observations by Asbestos Consultant are made. Any delay in the completion of the Project caused by lack of advance notice by Asbestos Abatement Contractor to Asbestos Consultant shall not be sufficient cause for any extension of time or extension of the Project completion deadline.

## 5.0 ELECTRICAL WORK

### 5.01 DESCRIPTION

- A. Work included:
1. Installation of temporary lighting and power necessary to perform the Work.
  2. Installation of Ground Fault Circuit Interrupters (GFCI) for Asbestos Abatement Contractor's and Asbestos Consultant's equipment.
  3. All electrical tie-ins are to be performed by licensed electricians.
- B. All materials and equipment required shall be:
1. Approved by Underwriters Laboratories and so labeled.
  2. For wire and cable, marked as required by Article 310-10 National Electrical Code.
  3. Installed by mechanics skilled in their trades, working under the direct supervision of competent experienced foremen or superintendents.
  4. Installed in compliance with all applicable Occupational Safety and Health Administration and city electrical codes.
- C. Install items specified at the proper time during progress of construction. Coordinate work operations with other trades as necessary.
- D. Decontaminate and remove all temporary lighting and other electrical items after completion of asbestos-containing material removal operations.

**END OF SECTION 02 82 13**

## **SECTION 03 05 80 - UNDER-SLAB VAPOR RETARDER**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Products Supplied Under This Section
  - 1. Vapor Retarder, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.
- B. Related Sections
  - 1. Section 03 30 00 Cast-in-place Structural Concrete
  - 2. Section 01 45 23 Structural Testing and Inspection

#### **1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
  - 2. ASTM E 154-88 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
  - 3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
  - 4. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- B. American Concrete Institute (ACI)
  - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

#### **1.4 SUBMITTALS**

- A. Quality Control / Assurance
  - 1. Full set of test results as per paragraph 8.3 of ASTM E 1745.
  - 2. Manufacturer's samples, literature
  - 3. Manufacturer's installation instructions for placement, seaming and pipe boot installation.

#### **1.5 SUBSTITUTIONS**

- A. Product Review
  - 1. Request must be made 14 days prior to bid date to allow time for proper review. Reviews will be at contractor's expense.
  - 2. Independent laboratory test results showing compliance with ASTM E 1745 Class A, a permeance less than 0.01 Perms (grains/(ft<sup>2</sup> \*hr \* in. Hg) before and after the mandatory

conditioning tests ASTM E 154 Sections 8,11,12, and 13. (Woven, and recycled plastics are not permitted)

3. Incomplete substitutions will not be accepted.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Vapor Retarder (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision. Vapor Retarder membrane must have the following properties.
  1. Permeance as tested after mandatory conditioning (ASTM E 154 sections 8,11,12,13) less than 0.01 Perms [grains/(ft<sup>2</sup> \*hr. \* in. Hg)]
  2. Other performance criteria
    - a. Strength: ASTM E 1745 Class A
    - b. Thickness: 15 mils minimum

### **2.2 ACCESSORIES**

- A. Seam Tape
  1. Tape must have the following qualities:
    - a. Water Vapor Transmission Rate ASTM E 96, 0.3 perms or lower
  2. Seam Tape
    - a. Manufacturer's standard seam tape.
    - b. Stego Crete Claw (for slabs on void boxes).
- B. Vapor Proofing Mastic
  1. Mastic must have the following qualities:
    - a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower
- C. Pipe Boots
  1. Construct pipe boots from vapor retarder material, pressure sensitive tape and/or mastic per manufacturer's instructions.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Ensure that subsoil is approved by architect or geotechnical firm
  1. Level and tamp or roll aggregate, sand, or tamped earth base.

### **3.2 INSTALLATION**

- A. Install Vapor Retarder:
  1. Installation shall be in accordance with manufacturer's written instructions and ASTM E 1643-09.
    - a. Unroll Vapor Retarder with the longest dimension parallel with the direction of the pour.
    - b. Lap Vapor Retarder over footings or seal to foundation walls.
    - c. Overlap joints 6 inches and seal with manufacturer's tape.

- d. Seal all penetrations (including pipes) per manufacturer's instructions.
- e. No penetration of the Vapor Retarder is allowed except for reinforcing steel and permanent utilities.
- f. Repair damaged areas by cutting patches of Vapor Retarder, overlapping damaged area 6 inches, and taping all four sides with tape.

**END OF SECTION 03 05 80**



## **SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes cast-in-place concrete formwork, for the following:
  - 1. Footings and/or piers.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Suspended slabs.
  - 5. Concrete toppings.
  - 6. Building frame members.
  - 7. Building walls.
- B. Related Sections:
  - 1. Section 01 45 23 "Testing and Inspection Services".
  - 2. Section 03 33 00 "Architectural Concrete".
  - 3. Section 03 30 00 "Cast In Place Concrete".
  - 4. Section 03 20 00 "Concrete Reinforcing".
  - 5. Section 03 47 13 "Tilt Up Concrete".
  - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".
  - 7. Section 03 53 00 "Concrete Topping".

#### **1.3 REFERENCES**

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
  - 1. American Concrete Institute (ACI):
    - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
    - b. ACI 301 – Specifications for Structural Concrete for Buildings
    - c. ACI 318 – Building Code Requirements for Structural Concrete
    - d. ACI 347 – Guide to Formwork for Concrete
    - e. ACI SP-4 – Formwork for Concrete.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design and engineering of formwork, including shores, reshores, false work, bracing, and other temporary supports as well as determining when temporary supports and bracing can safely be removed after the specified curing time is the Contractor's responsibility.
- B. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

- C. If any post tensioned members exist on the project, the formwork supporting those elements shall:
1. It is essential to take into account the stressing sequence of post-tensioned concrete in the design of the formwork. Any concrete element which is stressed can transfer its weight off the form work to the supporting concrete element in which case the forms for the supporting concrete element must be designed to support the entire load tributary of that element.
  2. Forms shall be designed and constructed to permit movement during stressing, both lifting and shortening of the concrete elements.
  3. Formwork supporting beams and girders shall be designed to support the weight of the beam or girder's entire tributary area.
  4. Formwork supporting post tensioned concrete elements shall not be removed until all concrete supported by the formwork has been fully stressed, but in no case shall the curing time before form removal be less than specified herein.
  5. Design, engineering, and production of shop drawings for the form work shall be performed under the supervision of a professional engineer.

### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Shop drawings for layout of pan type forms, if they exist on the project. Layout only - information and details about the support of these forms is not required, as it is the responsibility of the Contractor and his registered engineer
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- C. Manufacturer's product data and installation instruction for propriety materials used in exposed concrete work including form liners, release agents, form systems, ties, and accessories.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

### **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- B. Testing Agency Qualifications: Refer to Section 01 45 23.
- C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete."
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.

## **PART 2 - PRODUCTS**

### **2.1 FORM-FACING MATERIALS**

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Permanent Metal Forms for Slabs: Deck material, gauge and rib pattern shall be as noted on Drawings.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
  - 1. Pans shall be free of dents, irregularities, sag, rust or other deterioration.
  - 2. In areas permanently exposed to view, provide one piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.
- F. Load-bearing Rigid Board Insulating Fill Under Slabs:
  - 1. Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type X, 15 psi minimum compressive strength, 1.30 lb./cu. ft. (21 kg/cu. m) .

- a. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.
  - b. Thermal Resistance: (180-day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
  - c. Blowing Agent Formulation: Zero ozone depleting.
  - d. Install according to manufacturer's recommended instructions.
2. Expanded Polystyrene Board Insulation: Un-faced Flat Board Stock: Rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578 Type VIII, 15 psi minimum compressive strength .
    - a. Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: request info (info@insulfoam.com); Web: www.insulfoam.com
    - b. Blowing Agent Formulation: Zero ozone depleting.
    - c. Install according to manufacturer's recommended instructions.
- G. Formwork Accessories
1. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
  2. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
  3. Expansion-Contraction Joint Filler Material: Bonded fabric of thickness indicated on Drawings composed of cellular fibers securely bonded together and uniformly saturated with asphalt complying with ASTM D 1751.
  4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
    - a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
  5. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
    - a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
    - b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
    - c. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

### **PART 3 - EXECUTION**

#### **3.1 FORMWORK**

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class B, 1/4 inch
  3. Class C, 1/2 inch
  4. Class D, 1 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### **3.2 EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts that are attached to the formwork.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
  3. Install dovetail anchor slots in concrete structures as indicated.

4. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

### **3.3 REMOVING AND REUSING FORMS**

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
  3. Determine compressive strength of in place concrete by testing representative field-cured test specimens according to ACI 301.
- B. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
- C. In the absence of cylinder tests, formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period.
- D. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span. Two-way conventionally reinforced slabs shall then be reshored until they attain the specified 28 day strength.
- E. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems that allow form removal without displacing shores. However, the Contractor must demonstrate, to the satisfaction of the Architect, that the early removal of forms will not result in excessive sag, distortion or damage to the concrete elements.
- F. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- G. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### **3.4 SHORES AND RESHORES**

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

- B. The Contractor shall be solely responsible for proper shoring and reshoring. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- C. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. Reshores shall be located in the same position on each floor. No construction loads shall be placed on the new construction until all supporting reshores have been installed.
  - 1. Extend shores or reshores from ground to top level in structure three stories or less in height, unless noted otherwise.
  - 2. In structures over three stories in height, extend shores or reshores at least three levels under the level being placed. Extend shores beyond the minimum number of levels if required to ensure proper distribution of loads throughout the structure.
  - 3. In crawl spaces or basement, shores or reshores shall extend to mud pads seated firmly on the soil or to on grade construction.
- D. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- E. Bottom tier of reshores shall remain in place until the supported concrete has attained at least 85 percent of the specified 28-day compressive strength and construction loads in excess of 20 psf have been removed but not less than 14 days.

### **3.5 REUSE OF FORMS**

- A. Clean and repair surfaces of forms to be used in the Work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent.
- B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### **3.6 JOINTS**

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Otherwise, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are to be installed.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### **3.7 FINISHING FORMED SURFACES**

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform



color and texture. Do not apply cement grout other than that created by the rubbing process.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### **3.8 FINISHING FLOORS AND SLABS**

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
  - 1. Apply scratch finish to surfaces indicated or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces indicated or to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

### **3.9 MISCELLANEOUS CONCRETE ITEMS**

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment

**END OF SECTION 03 10 00**

## **SECTION 03 11 31 - VOID FORMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes corrugated paper void form material to create a temporary support for the placement of structural concrete slabs, grade beams, or walls over expansive soils.
- B. Related Sections:
  - 1. Section 01 45 23 "Testing and Inspection Services".
  - 2. Section 03 33 00 "Architectural Concrete".
  - 3. Section 03 30 00 "Cast In Place Concrete".
  - 4. Section 03 20 00 "Concrete Reinforcing".
  - 5. Section 03 47 13 "Tilt Up Concrete".
  - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated including manufacturer's written installation instructions.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

#### **1.6 QUALITY ASSURANCE**

- A. Design, place, and maintain void forms or carton forms for cast in place concrete work in compliance with ACI 347 "Guide to Form Work" unless otherwise shown or specified.
- B. Testing Agency Qualifications: Refer Section 01 45 23.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads, but not less than 800 pounds per square foot. Interior components shall be constructs as shown below:
1. Extra Fast Decomposition – Non wax impregnated, plain kraft paper and a water soluble adhesive.
  2. Fast Decomposition – Non wax impregnated, plain kraft paper and a moisture resistant adhesive.
  3. Moderate Decomposition – Plain kraft paper with a wax impregnated medium, but non wax impregnated liners and a moisture resistant adhesive.
  4. Slow Decomposition – Plain kraft paper with wax impregnated medium / liners and a moisture resistant adhesive.
  5. Extra Slow Decomposition – Wet strength paper with wax impregnated medium / liners and a moisture resistant adhesive.

### **2.2 VOID BOXES**

- A. Slabs: Use “Slab Void” with interior cell sizes 8”x8” or smaller, capable of sustaining a working load 800 psf, for slabs 8 inches thick or less. For slabs between 8 inches thick and 12 inches thick, void box shall be capable of sustaining a working load of 1000 psf. For slabs greater than 12 inches thick, consult with the structural engineer. For interior piers, provide pre-manufactured curved end units against top of piers for tight fit.
- B. Grade beams and walls: Rectangular shape as shown on plans. Trapezoidal void boxes are not acceptable. Provide end caps at ends of forms and corners. Provide pre-manufactured curved end units against top of piers for tight fit. Cartons shall be capable of sustaining a working load of 200 psf times the height of the pour (in feet), without significant deformation.
- C. Design and maintain void forms to maintain all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. This includes, but is not limited to, live load, dead load, and weight of moving equipment, height of concrete drop, vibrator frequency, ambient temperature, soil pressures, and lateral stability.
- D. Form material shall be designed to lose it strength upon prolonged contact with the moisture that normally accumulates beneath slabs and beams on grade. Sufficient deterioration to cushion uplift forces shall take place within a maximum of 8 weeks after placement of concrete.

### **2.3 RELATED PRODUCTS**

- A. Protection Board: Used over carton forms under slabs and under grade beam or walls wider than 12 inches. 1/4-inch minimum hardboard.
- B. Soil Retainers: High density, polyethylene (HDPE). “Sure Retainer” by Motzblock or ½ inch thick “Backfill Retainer” by Sure Void Products. Retainers shall be sized such that they extend a minimum of 4 inches above the void box and 4 inches below the void box.

### **PART 3 - EXECUTION**

#### **3.1 CARTON FORMS**

- A. A void shall be constructed below all structural elements supported by piers to separate these elements from the soil. Where carton forms are used to construct this void the construction shall comply with the following:
1. Seal discontinuous ends of carton forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between carton form sections.
  2. Pre-manufactured carton forms with circular edges shall be used around all drilled piers. Cutting of square carton forms is not acceptable.
  3. Do not allow any portion of carton forms to fall within the circumference of piers causing reduction in bearing area.
  4. Protect carton forms from water. Do not install carton forms during wet weather or on wet ground. Carton forms which become wet prior to placement of concrete shall be removed and replaced.
  5. Protect carton forms, from puncturing, collapsing, or crushing during construction. All damaged carton forms must be replaced prior to concrete placement.
  6. Exercise care in placement of concrete to avoid collapse of carton forms. If carton forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created and protected by installing the specified soil retainers.
  7. Carton forms wrapped in plastic to protect them from water, shall have the plastic ripped or punctured immediately prior to concrete placement.
- B. Carton Forms Under Slabs
1. Carton forms under slabs shall be protected on top by a protection board as specified with the specified vapor retarder on top of the protection board.
  2. Carton forms shall not be placed under soil supported slabs on grade.

**END OF SECTION 03 11 31**

## **SECTION 03 15 13 - WATERSTOPS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.
- B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.
- C. Non-metallic waterstops for use in concrete joints subjected to acids, bases, alcohols, oils, solvents, or other chemicals.

#### **1.3 REFERENCES**

- A. PVC WATERSTOP
  1. Corps of Engineers: CRD-C 572-74
  2. American Society for Testing Materials (ASTM)
  3. Bureau of Reclamation: C-902
  4. Canadian General Standards Board: 41-GP-35M Types 1 & 3
  5. ACI 350.2: Concrete Structures for Containment of Hazardous Materials
- B. HYDROPHILIC WATERSTOP
  1. American Society for Testing Materials (ASTM)

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

#### **1.5 SUBMITTALS**

- A. Submit shop drawings and fabrication drawings indicating placement of waterstops and shop fabrications.
- B. Submit manufacturer's test data for chemical resistance.

### **PART 2 - PRODUCTS**

#### **2.1 PVC WATERSTOPS FOR EXPANSION JOINTS**

- A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak or approved equal.

- B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.
- C. Profile: Ribbed with center bulb.
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F
Stiffness in Flexure	ASTM D 747	600 psi min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalis after 7 days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% +/- 5 points

**2.2 CHEMICALLY RESISTANT FLEXIBLE WATERSTOP**

- A. Thermoplastic elastomeric rubber waterstops resistant to oil, solvents, and chemicals as manufactured by Westec or approved equal.
- B. Chemical resistance testing to be performed by independent ASTM certified laboratory.
- C. Profile: Ribbed with center bulb
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance requirements as follows:

Property	Test Method	Unexposed Value
Tensile Strength	ASTM D638	2000 psi
Ultimate Elongation	ASTM D638	450%
100% Modulus	ASTM D638	1000 psi
Shore A Hardness	ASTM D2240	85 units
Low Temp Brittleness	ASTM D746	No Failure @ -70 F

- F. Waterstop material should show less than +/- 30% change in material properties, including weight gain after 7-day exposure to selected chemicals, per ASTM D 471 testing.

**2.3 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS**

- A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number (fill in profile style number).
- B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
- C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- D. Performance Requirements as follows:

**Chloroprene Rubber**

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

**Modified Chloroprene (Hydrophilic) Rubber**

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70o F	3 to 1 min.

**2.4 ACCESSORIES**

- A. PVC and Chemically Resistant Waterstops
  - 1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
  - 2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
  - 3. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.
  - 4. Splices to be free from defects.
- B. Hydrophilic Waterstops
  - 1. Provide Greenstreak 7300 two component epoxy gel to secure HYDROTITE to rough, wet (or dry) concrete.

2. Provide LEAKMASTER single component hydrophilic sealant to secure HYDROTITE to rough, dry concrete.
3. Provide cyanacrylate adhesive (super glue) for all splices.
4. Provide LEAKMASTER as addition to cyanacrylate adhesive at all splices for added insurance (Optional).

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. PVC and Chemically Resistant Waterstops
1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
  2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
  3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12" on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.
  4. Install in longest lengths practicable.
  5. Ensure steel reinforcing bars do not interfere with proper position of waterstop.
  6. Clean concrete joints of dirt and construction debris prior to second pour of concrete.
  7. Cut waterstop ends with miter guide and circular saw to ensure good, full contact at joints.
  8. At expansion joints, keep center bulb unembedded at joint centerline.
- B. Hydrophilic Waterstop
1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
  2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER (LEAKMASTER is optional).
  3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
  4. Follow approved manufacturer written recommendations.
  5. Install in longest length practicable.
- C. Hydrophilic and PVC Intersections
1. Maintain continuity of waterstops at all intersections and transitions.
  2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
  3. Follow approved manufacturer written recommendations.
- D. Retrofit Waterstop
1. Prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond.
  2. Apply continuous bed of epoxy to concrete 1/8 inch thick.
  3. Embed retrofit waterstop in uncured epoxy.
  4. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6 inches OC max. Use batten bars on top and bottom.
  5. Tool continuous layer of epoxy over batten bars and bolts to protect from corrosion.
  6. Use expansion joint filler at moving joints to minimize shear stresses.



- E. Concrete Placement at Waterstop
1. Carefully place concrete without displacing waterstop from proper position.
  2. Thoroughly and systematically vibrate concrete around waterstop to obtain impervious, void free concrete in vicinity of joint and to maximize intimate contact between concrete and waterstop.
  3. After first pour, clean un-embedded waterstop leg to ensure full contact of second pour concrete.

**END OF SECTION 03 15 13**

## **SECTION 03 20 00 - CONCRETE REINFORCING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes cast-in-place concrete reinforcement, for the following:
1. Footings and/or piers.
  2. Foundation walls.
  3. Slabs-on-grade.
  4. Suspended slabs.
  5. Concrete toppings.
  6. Building frame members.
  7. Building walls.
- B. Related Sections:
1. Section 01 45 23 "Testing and Inspection Services".
  2. Section 03 10 00 "Concrete Forming and Accessories".
  3. Section 03 30 00 "Cast In Place Concrete".
  4. Section 03 47 13 "Tilt Up Concrete".
  5. Section 03 38 16 "Unbonded Post Tensioned Concrete".
  6. Section 04 22 00 "Concrete Unit Masonry".
  7. Section 31 20 00 "Earth Moving".
  8. Section 31 63 29 "Drilled Concrete Piers".

#### **1.3 REFERENCES**

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. American Concrete Institute (ACI)
    - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
    - b. ACI 301 – Specifications for Structural Concrete for Buildings
    - c. ACI 315 – Details and Detailing of Concrete Reinforcement
    - d. SP-66 ACI Detailing Manual
  2. American Welding Society (AWS)
    - a. AWS D1.1 – Structural Welding Code
  3. Concrete Reinforcing Steel Institute (CRSI)
    - a. CRSI – Manual of Standard Practice
    - b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
    - c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
  4. American Society of Testing Materials (ASTM)

- a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
  - b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
  - c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
  - e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
  - f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
  - g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.
- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 "Details and Detailing of Concrete Reinforcement."
  1. Do not reproduce the structural drawings for use as shop drawings.
- C. Bar Supports: Submit manufacturer's product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  1. Steel reinforcement and accessories.

#### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

## **PART 2 - PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 75 as indicated on Drawings, deformed.
- C. Low-Alloy-Steel Reinforcing Bars for bars to be welded: ASTM A 706, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.
- D. Add the following paragraph below for stainless-steel reinforcement. Retain one of two options for reinforcement type.
- E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.
- F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- G. Plain-Steel Wire: ASTM A 82, as drawn.
- H. Deformed-Steel Wire: ASTM A 496.
- I. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

## **2.2 REINFORCEMENT ACCESSORIES**

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  - 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

## **2.3 FABRICATING REINFORCEMENT**

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not bend or straighten reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:
  - 1. Sheared length: Plus or minus 1 inch.
  - 2. Depth of truss bars: Plus 0, minus ½ inch.
  - 3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
  - 4. Other bends: Plus or minus 1 inch.
- B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

## **2.4 DOWEL BAR ANCHORS/SPLICERS**

- A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable:
  - 1. Richmond Screw Anchor "Dowel Bar Splicer"
  - 2. Erico "Lenton Form Saver"
  - 3. Dayton Barsplice "Grip-Twist"

## **2.5 MECHANICAL SPLICES**

- A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O test reports. The following bar splicing systems are acceptable:
  - 1. Erico "Cadweld C-Series"
  - 2. Erico "Lenton"
  - 3. Dayton Barsplice "Bar Grip"

4. Dayton Barsplice "Grip Twist"

## **2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES**

- A. Steel Shapes and Plates: Conform to ASTM A36, "Specification for Structural Steel".
- B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- C. Welding Electrodes: AWS 5.5, Series E70.
- D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- E. All metal assemblies exposed to earth, weather, or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

## **2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES**

- A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and AWS D1.1. Welding shall be done by AWS certified welders.
- B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.
- C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.
- D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

## **PART 3 - EXECUTION**

### **3.1 EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

### 3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.
- G. Place bars to following tolerances:
  1. Clear distance to formed surfaces: Plus or minus 1/4 inch.
  2. Minimum spacing between bars: Minus 1/4 inch.
  3. Top bars in slabs and beams:
    - a. Members 8 inches deep or less: Plus or minus 1/4 inch.
    - b. Members between 8 and 24 inches deep: Plus or minus 1/2 inch.
    - c. Members more than 24 inches deep: Plus or minus 1 inch.
  4. Crosswise of members: Spaced evenly within 2 inches.
  5. Length of members: Plus or minus 2 inches.
- H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.
- I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

**3.3 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: See Section 01 45 23.
- B. Inspections:
  - 1. Steel reinforcement placement.
  - 2. Steel reinforcement welding.

**END OF SECTION 03 20 00**



## **SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Suspended slabs.
  - 5. Concrete toppings.
  - 6. Building frame members.
  - 7. Building walls.
- B. Related Sections:
  - 1. Section 01 45 23 "Structural Testing and Inspection Services".
  - 2. Section 03 20 00 "Concrete Forming and Accessories".
  - 3. Section 03 10 00 "Concrete Reinforcing".
  - 4. Section 03 11 31 "Void Forms".
  - 5. Section 03 15 13 "Waterstops".
  - 6. Section 03 05 80 "Under-slab Vapor Barrier – Retarder".
  - 7. Section 03 47 13 "Tilt Up Concrete".
  - 8. Section 31 63 29 "Drilled Concrete Piers and Shafts".

#### **1.3 REFERENCES**

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
  - 1. ACI 301 – Specification for Structural Concrete.
  - 2. ACI 302 – Guide for Concrete Floor Slab Construction.
  - 3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
  - 4. ACI 305 – Hot Weather Concreting.
  - 5. ACI 306 – Cold Weather Concreting.
  - 6. ACI 308 – Guide to Curing Concrete.
  - 7. ACI 309 – Guide for Consolidating Concrete.
  - 8. ACI 311 – ACI Manual for Concrete Inspection.
  - 9. ACI 318 – Building Code Requirements for Reinforced Concrete.
  - 10. ACI 347 – Guide to Concrete Formwork.
  - 11. ACI 207 – Mass Concrete.
  - 12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
14. ACI 212.3 – Chemical Admixture for Concrete.
15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
16. ACI 214 – Evaluation of Strength Test Results of Concrete.
17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
18. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.

- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

#### 1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
  2. Proportions of cement, fine, and coarse aggregate, and water.
  3. Design strength.
  4. Maximum slump.
  5. Air Content.
  6. Maximum water / cement ratio.
  7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
  8. Type cement and aggregates.
  9. Type and quantities of all admixtures.
  10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
  11. Type, color, and quantities of integral coloring compounds, where applicable.
  12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.
- D. Formwork Shop Drawings: Refer Section 03 10 00.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Fiber reinforcement.
  - 4. Curing compounds.
  - 5. Floor and slab treatments.
  - 6. Bonding agents.
  - 7. Adhesives.
  - 8. Semi rigid joint filler.
  - 9. Joint-filler strips.
  - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
  - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: See Section 01 45 23.
  - 1. Contractor's responsibility to testing laboratory.
    - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
    - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
    - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete."
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
  - 1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
- H. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

## **PART 2 - PRODUCTS**

### **2.1 FORM-FACING MATERIALS**

- A. See Section 03 10 00.

### **2.2 STEEL REINFORCEMENT**

- A. See Section 03 20 00.

### **2.3 REINFORCEMENT ACCESSORIES**

- A. See Section 03 20 00.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94 and potable.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride (except the chemical admixture Xypex).
  - 1. Water-Reducing Admixture: ASTM C 494, Type A.
  - 2. Retarding Admixture: ASTM C 494, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
  - 7. Waterproofing Admixture: Xypex Admix C-1000
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ChemMasters.
    - b. Davis Colors.
    - c. Dayton Superior Corporation.
    - d. Hoover Color Corporation.
    - e. Lambert Corporation.
    - f. QC Construction Products.
    - g. Rockwood Pigments NA, Inc.
    - h. Scofield, L. M. Company.

- i. Solomon Colors, Inc.
2. Color: As selected by Architect from manufacturer's full range.

## **2.6 FIBER REINFORCEMENT**

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. 3M; Scotchcast Polyolefin Fibers 2".
    - b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
    - c. FORTA Corporation; FORTA FERRO.
    - d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
    - e. Nycon, Inc.; XL.
    - f. Propex Concrete Systems Corp.; Fibermesh 650.
    - g. Sika Corporation; Sika Fiber MS or MS10.

## **2.7 CONCRETE MIX DESIGNS**

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength  $f'c$  by the amount defined in ACI 301.

## **2.8 VAPOR RETARDERS**

- A. See Section 03 05 80.

## **2.9 FLOOR AND SLAB TREATMENTS**

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Anti-Hydro International, Inc.; Emery.
    - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
    - c. Lambert Corporation; EMAG-20.
    - d. L&M Construction Chemicals, Inc.; Grip It.
    - e. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Anti-Hydro International, Inc.; A-H Alox.

- b. L&M Construction Chemicals, Inc.; Grip It AO.
- c. Master Builders Solutions; MasterTop 120SR (Pre-2014: Frictex NS)

## 2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ChemMasters; Chemisil Plus.
    - b. ChemTec Int'l; ChemTec One.
    - c. Conspec by Dayton Superior; Intraseal.
    - d. Curecrete Distribution Inc.; Ashford Formula.
    - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
    - f. Edoco by Dayton Superior; Titan Hard.
    - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
    - h. Kaufman Products, Inc.; SureHard.
    - i. L&M Construction Chemicals, Inc.; Seal Hard.
    - j. Meadows, W. R., Inc.; LIQUI-HARD.
    - k. Metalcrete Industries; Floorsaver.
    - l. Nox-Crete Products Group; Duro-Nox.
    - m. Symons by Dayton Superior; Buff Hard.
    - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
    - o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Advanced Floor Products; Retro-Plate 99.
    - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
    - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

## 2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    - b. ChemMasters; SprayFilm.
    - c. Conspec by Dayton Superior; Aquafilm.
    - d. Dayton Superior Corporation; Sure Film (J-74).
    - e. Edoco by Dayton Superior; BurkeFilm.
    - f. Euclid Chemical Company (The), an RPM company; Eucobar.
    - g. Kaufman Products, Inc.; Vapor-Aid.

- h. Lambert Corporation; LAMBCO Skin.
  - i. L&M Construction Chemicals, Inc.; E-CON.
  - j. Master Builders Solutions; MasterKure ER 50 (Pre-2014: Conflim).
  - k. Meadows, W. R., Inc.; EVAPRE.
  - l. Metalcrete Industries; Waterhold.
  - m. Nox-Crete Products Group; MONOFILM.
  - n. Sika Corporation; SikaFilm.
  - o. SpecChem, LLC; Spec Film.
  - p. Symons by Dayton Superior; Finishing Aid.
  - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
  - r. Unitex; PRO-FILM.
  - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    - b. ChemMasters; Safe-Cure Clear.
    - c. Conspec by Dayton Superior; W.B. Resin Cure.
    - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    - e. Edoco by Dayton Superior; Res X Cure WB.
    - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    - g. Kaufman Products, Inc.; Thinfilm 420.
    - h. Lambert Corporation; AQUA KURE - CLEAR.
    - i. L&M Construction Chemicals, Inc.; L&M Cure R.
    - j. Meadows, W. R., Inc.; 1100-CLEAR.
    - k. Nox-Crete Products Group; Resin Cure E.
    - l. Right Pointe; Clear Water Resin.
    - m. SpecChem, LLC; Spec Rez Clear.
    - n. Symons by Dayton Superior; Resi-Chem Clear.
    - o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
    - p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ChemMasters; Polyseal WB.
    - b. Conspec by Dayton Superior; Sealcure 1315 WB.
    - c. Edoco by Dayton Superior; Cureseal 1315 WB.
    - d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.



- e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
  - f. Lambert Corporation; UV Safe Seal.
  - g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
  - h. Master Builders Solutions; MasterKure CC 1315WB (Pre 2014: Kure1315).
  - i. Meadows, W. R., Inc.; Vocomp-30.
  - j. Metalcrete Industries; Metcure 30.
  - k. Right Pointe; Right Sheen WB30.
  - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
  - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## **2.12 RELATED MATERIALS**

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## **2.13 REPAIR MATERIALS**

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

#### **2.14 CONCRETE MIXTURES, GENERAL**

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

#### **2.15 NON-SHRINK GROUT**

- A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:
  - 1. "Euco NS" by Euclid Chemical Company
  - 2. "Masterflow 713" by Master Builders.

**2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS**

- A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

**2.17 FABRICATING REINFORCEMENT**

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

**2.18 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

**PART 3 - EXECUTION**

**3.1 FORMWORK**

- A. See Section 03 10 00.

**3.2 EMBEDDED ITEMS**

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Install dovetail anchor slots in concrete structures as indicated.

**3.3 REMOVING AND REUSING FORMS**

- A. See Section 03 10 00.

**3.4 SHORES AND RESHORES**

- A. See Section 03 10 00.

**3.5 VAPOR RETARDERS/BARRIERS**

- A. See Section 03 05 80.

**3.6 STEEL REINFORCEMENT**

- A. See Section 03 20 00

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### **3.9 FINISHING FORMED SURFACES**

- A. See Section 03 10 00.

### **3.10 FINISHING FLOORS AND SLABS**

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated and/or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and/or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  2. Finish surfaces according to ASTM E 1155, for a randomly trafficked floor surface.

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
  - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
  - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
  - 2. After broadcasting and tamping, apply float finish.
  - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

### 3.11 CONCRETE FLOOR FINISH TOLERANCES

- A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
  - 1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, FI =25; with minimum local values of flatness, Ff =24; and levelness, FI =17.
  - 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, FI = 20; with minimum local values of flatness, Ff =17; and levelness, FI =15.
- B. Floor Elevation Tolerance Envelope:
  - 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
    - a. Slab-on-Grade, or Slab-on-Void Construction: +/- 3/4"
    - b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
    - c. Top surfaces of all other slabs: +/- 3/4"
    - d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-

place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### **3.13 CONCRETE PROTECTING AND CURING**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.



- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
  4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### **3.14 LIQUID FLOOR TREATMENTS**

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 28 days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
  1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
  2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
  3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
  4. Control and dispose of waste products produced by grinding and polishing operations.
  5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

### **3.15 JOINT FILLING**

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### **3.16 CONCRETE SURFACE REPAIRS**

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's

written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### **3.17 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: See Section 01 45 23.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### **3.18 PROTECTION OF LIQUID FLOOR TREATMENTS**

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
- NOTE: Add articles for flowable fill in products and execution. NEEDS RESEARCH.

**END OF SECTION 03 30 00**

## **SECTION 03 35 00 – CONCRETE FINISHING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Single application sealer-hardener for concrete floors.
  - 2. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's specifications, application instructions, and recommendations. Include data substantiating product complies with requirements of the contract documents.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
  - 2. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
- B. Manufacturer Qualifications: Provide products produced by a company specializing in production of concrete sealers for minimum of 5 years.
- C. Test Area: Test a representative area of no less than 10 ft. by 10 ft. (and no more than 10% of the total floor area) to confirm surface preparation procedures, coverage rate, reaction time, finished appearance, etc. Use the manufacturers' application instructions. Let test area dry thoroughly before inspection. Get owner's approval before proceeding. Keep test area available for comparison throughout the project.

#### **1.5 PROJECT CONDITIONS**

- A. Environmental Requirements: Do not proceed with installation until areas to receive Work are enclosed and temperature and relative humidity are stabilized and maintained for optimum quality control.
- B. Environmental Limitations: Comply with coating manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and conditions affecting floor treatment application. Do not apply coating until wet Work in spaces is complete and dry; and overhead Work, including installing mechanical systems, lighting, and athletic equipment, is complete.
  - 1. Apply floor coatings when substrate temperature and surrounding air temperatures are between 50 degrees F and 95 degrees F (10 degrees F and 35 degrees C).
  - 2. Do not apply floor coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Specifications: Consolideck LS as manufactured by PROSOCO, Inc. Other manufacturers are subject to compliance with requirements, provide basis of design product or comparable by one of the following:
  - 1. Evercrete Company.
  - 2. WR Meadows.
  
- B. Materials: the premium sealer, hardener and densifier for concrete surfaces. This penetrating lithium silicate treatment reacts with the concrete to produce insoluble calcium silicate hydrate within the concrete pores. Treated surfaces resist damage from water and surface abrasion. The increased surface hardness reduces dusting and simplifies maintenance, producing a cleaner, healthier environment. Product will not trigger or contribute to surface ASR (alkali silicate reaction).
  
- C. Technical Data:
  - 1. Form: Clear, water-like liquid.
  - 2. Specific Gravity: 1.10.
  - 3. pH: 11.0.
  - 4. Weight/Gallon: 9.2 pounds.
  - 5. Active Content: 14.5 percent.
  - 6. Total Solids: 14.5 percent.
  - 7. VOC Content: 0 grams per Liter. Complies with all known national, state and district.
  - 8. AIM VOC regulations.
  - 9. Flash Point: Not flammable.
  - 10. Freeze Point: 32 degrees Fahrenheit.
  - 11. Shelf Life: 2 years in unopened, factory-sealed container.
  
- D. Polishing:
  - 1. Apply concrete polishing in accordance with manufacturer's instructions to the selected sheen level.
  
  - 2. Polish: Level 3, High Sheen, 800 Grit.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates for conditions affecting performance and conditions of floor treatment.
  - 1. Verify compatibility with and suitability of substrates, including existing finishes or primers.
  - 2. Verify plasticizers in existing concrete substrate will not impair bond.
  - 3. Proceed with installation after correcting unsatisfactory conditions

### **3.2 PREPARATION**

- A. Clean substrate, removing chalk lines, pencil lines and other layout lines as well as projections and substances detrimental to the Work; comply with recommendations of manufacturer of products to be installed for proper preparation procedures. Mask off or protect adjacent surfaces not scheduled to receive sealer.

### **3.3 APPLICATION**

- A. Calculating Target Coverage Rate:
1. Prepare the test section in accordance with manufacturer's published preparation information. Surface must be clean, dry and absorbent. Surfaces should wet uniformly.
  2. Pour one gallon of product into a clean pump up sprayer. Lightly apply sufficient product to wet the surface without producing puddles.
  3. Use a clean microfiber pad to spread the product and ensure uniform wetting. Scrubbing is not necessary.
  4. If surfaces dry immediately, increase your rate of application. Surface should remain wet for 5–10 minutes. Adjust rate of application to eliminate puddles.
  5. Repeat steps 2 through 4 as needed to determine the correct rate of application. Measure the test area to establish the Target Coverage Rate per gallon.
- B. Cured, Steel Troweled Concrete:
1. The prepared surface must be clean, dry and absorbent, and must wet uniformly. Test surface absorbency with a light water spray. In hot, dry weather, pre-wet the concrete with fresh water. Allow any standing water to evaporate.
  2. Apply a single coat using a low pressure sprayer. Apply sufficient product to wet the surface without producing puddles. Use a clean microfiber pad to spread the product evenly and ensure uniform wetting. Avoid spreading once drying begins. Scrubbing is not necessary.
  3. If surfaces dry immediately, increase the rate of application. Surface should remain wet for 5–10 minutes. Adjust rate of application to eliminate puddles.
  4. Allow treated surfaces to dry.
  5. Remove any dried powder residue using a stiff broom, power sweeper or auto-scrubbing machine.
  6. For immediate, enhanced shine, buff or burnish the dry concrete surface in both directions using an orbital floor machine or burnisher equipped with an appropriate polishing pad. This is a dry buffing operation.

### **3.1 CLEANING**

- A. After completing application, clean spattered surfaces. Remove spattered sealer by washing or other appropriate methods for coating. Do not scratch or damage adjacent finished surfaces.
- B. Clean Up: Remove rubbish, empty cans, rags, and discarded materials from site daily. Rinse and recycle or legally dispose of sealer and coating containers.

### **3.2 PROTECTION**

- A. Institute protective procedures and install protective materials as required to ensure that Work of this section will be without damage or deterioration at substantial completion.

**END OF SECTION 03 35 00**

## **SECTION 03 35 43– POLISHED CONCRETE FINISHING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Single application sealer-hardener for concrete floors.
  2. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's specifications, application instructions, and recommendations. Include data substantiating product complies with requirements of the contract documents.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
  2. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
- B. Manufacturer Qualifications: Provide products produced by a company specializing in production of concrete sealers for minimum of 5 years.
- C. Test Area: Test a representative area of no less than 10 ft. by 10 ft. (and no more than 10% of the total floor area) to confirm surface preparation procedures, coverage rate, reaction time, finished appearance, etc. Use the manufacturers' application instructions. Let test area dry thoroughly before inspection. Get owner's approval before proceeding. Keep test area available for comparison throughout the project.

#### **1.5 PROJECT CONDITIONS**

- A. Environmental Requirements: Do not proceed with installation until areas to receive Work are enclosed and temperature and relative humidity are stabilized and maintained for optimum quality control.
- B. Environmental Limitations: Comply with coating manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and conditions affecting floor treatment application. Do not apply coating until wet Work in spaces is complete and dry; and overhead Work, including installing mechanical systems, lighting, and athletic equipment, is complete.
  1. Apply floor coatings when substrate temperature and surrounding air temperatures are between 50 degrees F and 95 degrees F (10 degrees F and 35 degrees C).
  2. Do not apply floor coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F (3 degrees C) above the dew point; or to damp or wet surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Specifications: Consolideck LS as manufactured by PROSOCO, Inc. Other manufacturers are subject to compliance with requirements, provide basis of design product or comparable by one of the following:
1. Evercrete Company.
  2. WR Meadows.
- B. Materials: the premium sealer, hardener and densifier for concrete surfaces. This penetrating lithium silicate treatment reacts with the concrete to produce insoluble calcium silicate hydrate within the concrete pores. Treated surfaces resist damage from water and surface abrasion. The increased surface hardness reduces dusting and simplifies maintenance, producing a cleaner, healthier environment. Product will not trigger or contribute to surface ASR (alkali silicate reaction).
- C. Technical Data:
1. Form: Clear, water-like liquid.
  2. Specific Gravity: 1.10.
  3. pH: 11.0.
  4. Weight/Gallon: 9.2 pounds.
  5. Active Content: 14.5 percent.
  6. Total Solids: 14.5 percent.
  7. VOC Content: 0 grams per Liter. Complies with all known national, state and district.
  8. AIM VOC regulations.
  9. Flash Point: Not flammable.
  10. Freeze Point: 32 degrees Fahrenheit.
  11. Shelf Life: 2 years in unopened, factory-sealed container.
- D. Polishing:
1. Apply concrete polishing in accordance with manufacturer's instructions to the selected sheen level.
  2. Polish: Level 3, High Sheen, 800 Grit.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates for conditions affecting performance and conditions of floor treatment.
1. Verify compatibility with and suitability of substrates, including existing finishes or primers.
  2. Verify plasticizers in existing concrete substrate will not impair bond.
  3. Proceed with installation after correcting unsatisfactory conditions

### **3.2 PREPARATION**

- A. Clean substrate, removing chalk lines, pencil lines and other layout lines as well as projections and substances detrimental to the Work; comply with recommendations of manufacturer of products to be installed for proper preparation procedures. Mask off or protect adjacent surfaces not scheduled to receive sealer.

### **3.3 APPLICATION**

- A. Calculating Target Coverage Rate:



1. Prepare the test section in accordance with manufacturer's published preparation information. Surface must be clean, dry and absorbent. Surfaces should wet uniformly.
  2. Pour one gallon of product into a clean pump up sprayer. Lightly apply sufficient product to wet the surface without producing puddles.
  3. Use a clean microfiber pad to spread the product and ensure uniform wetting. Scrubbing is not necessary.
  4. If surfaces dry immediately, increase your rate of application. Surface should remain wet for 5–10 minutes. Adjust rate of application to eliminate puddles.
  5. Repeat steps 2 through 4 as needed to determine the correct rate of application. Measure the test area to establish the Target Coverage Rate per gallon.
- B. Cured, Steel Troweled Concrete:
1. The prepared surface must be clean, dry and absorbent, and must wet uniformly. Test surface absorbency with a light water spray. In hot, dry weather, pre-wet the concrete with fresh water. Allow any standing water to evaporate.
  2. Apply a single coat using a low pressure sprayer. Apply sufficient product to wet the surface without producing puddles. Use a clean microfiber pad to spread the product evenly and ensure uniform wetting. Avoid spreading once drying begins. Scrubbing is not necessary.
  3. If surfaces dry immediately, increase the rate of application. Surface should remain wet for 5–10 minutes. Adjust rate of application to eliminate puddles.
  4. Allow treated surfaces to dry.
  5. Remove any dried powder residue using a stiff broom, power sweeper or auto-scrubbing machine.
  6. For immediate, enhanced shine, buff or burnish the dry concrete surface in both directions using an orbital floor machine or burnisher equipped with an appropriate polishing pad. This is a dry buffing operation.

### **3.1 CLEANING**

- A. After completing application, clean spattered surfaces. Remove spattered sealer by washing or other appropriate methods for coating. Do not scratch or damage adjacent finished surfaces.
- B. Clean Up: Remove rubbish, empty cans, rags, and discarded materials from site daily. Rinse and recycle or legally dispose of sealer and coating containers.

### **3.2 PROTECTION**

- A. Institute protective procedures and install protective materials as required to ensure that Work of this section will be without damage or deterioration at substantial completion.

**END OF SECTION 03 35 00**

## **SECTION 03 52 16 - LIGHTWEIGHT INSULATING CONCRETE DECK SYSTEM**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 – GENERAL**

#### **1.1 SECTION INCLUDES**

- A. It is the intent of this Section,
  - 1. to include the lightweight insulating concrete, and EPS roof insulation for all areas of existing roof construction, and
  - 2. that all Work be performed by the lightweight insulating concrete Sub-contractor.

#### **1.2 RELATED WORK**

- A. All Sections of Work pertinent to the roofing system, including mechanical, plumbing and electrical items penetrating metal deck, lightweight insulating concrete, rough carpentry, roof insulation, subsequent roofing and sheet metal flashing and trim.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications, instructions and other data needed for proper placement of the lightweight insulating concrete roof insulation system.
  - 2. Manufacturer's installation instructions.
- B. Mix Design: Indicate materials and proportions of proposed mix.
- C. Applicator's Qualifications: Submit a letter from the proposed lightweight insulating concrete system supplier confirming that the Contractor is approved to install the proposed lightweight insulating concrete system. Refer also to Paragraph 1.5, A.
- D. Certifications:
  - 1. Manufacturer's affidavit that materials used in Project contain no asbestos.
  - 2. On completion of installation, furnish Architect with Certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.
  - 3. Manufacturer's certification that system meets or exceeds UL-90 wind up-lift and UL Class A fire rating.
  - 4. Manufacturer's certification that system meets or exceeds Factory Mutual Research Corp. FM I-90 wind up-lift rating.
- E. Warranty:
  - 1. Submit a sample copy of the warranty covering the proposed lightweight insulating concrete system.
  - 2. Submit a sample copy of the roof system warranty covering the proposed lightweight insulating concrete system and roof membrane system.
  - 3. Refer to the roofing system specification section and coordinate the lightweight insulating concrete system warranty with the roof system warranty.

#### **1.4 REFERENCES**

- A. Comply with all applicable recommendations of the referenced standards. In any conflict between referenced standards, the more stringent requirements shall govern.
  - 1. American National Standards Institute/Underwriters' Laboratories, Inc. (ANSI/UL)

2. American Society for Testing and Material (ASTM)
  - a. A525, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
  - b. C150, Standard Specification for Portland Cement
  - c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
  - d. C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete
  - e. C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
  - f. E119, Standard Test Methods for Fire Tests of Building Construction and Materials
3. National Roofing Contractors Association (NRCA)
4. Occupational Safety and Health Administration (OSHA)
5. Underwriters' Laboratories, Inc. (UL)
  - a. Wind Uplift Class 90 - UL-90
  - b. Fire Ratings - Class A
6. Vermiculite Association (VA)

## 1.5 QUALITY ASSURANCE

- A. Applicator:
  1. A firm regularly engaged in and properly equipped for the installation of lightweight fill, and acceptable to the fill manufacturer, which has installed at least five (5) million square feet in the last five (5) years.
  2. Key Person Requirement: A thoroughly trained and experienced employee of the Installer, who is acceptable to the Roofing Consultant, shall be present at all times during the execution of work specified in this Section, and direct that work.
  3. Approved in writing by manufacturer to install the roof lightweight insulating concrete deck system.
  4. Responsible for ensuring positive drainage.
  5. **No ponding** water will be acceptable.
  6. Perform water test prior to application of roof system. Architect will be present, provide 48 hours' notice in advance of water testing.
- B. Agency Approvals: Provide products, execution, and material thickness to conform to the applicable code requirements for the required fire resistance ratings, wind uplift classifications, insulation values, and diaphragm values.
- C. Diaphragm Construction: Incorporate metal decking thickness, welding pattern, and minimum compressive strength of the lightweight insulating concrete to achieve diaphragm design values for edge and field conditions as specified to meet applicable code requirements.
- D. Fire Resistance Classifications: Provide a lightweight insulating concrete system meeting the following fire resistance standards:
  1. Tested by UL in accordance with the procedures of ASTM E119 and listed in the UL "Fire Resistance Directory".
  2. Approval Rating: Class A
- E. Wind Uplift Classifications: Provide a lightweight insulating concrete system meeting the following wind uplift standards:
  1. Tested by UL in accordance and listed in the UL "Roofing Materials Directory" for wind uplift resistance.
  2. Approval Rating: UL-90
  3. Tested and approved by Factory Mutual Research Corp. for wind up-lift rating of I-90.

- F. Inspection and Testing Laboratory Services:
  - 1. Test results shall meet or exceed established Standards. Refer to Section 01115, Inspection and Testing Laboratory Services.
  - 2. The Owner will select the Inspection and Testing Laboratory and pay for the cost of tests to determine the dry density and compressive strength.
  - 3. Compressive strength shall be determined in accordance with ASTM C495.
  - 4. Wet and dry density range shall be in accordance with ASTM C495.
  - 5. Polystyrene (EPS) density shall be in accordance with ASTM C578.
- G. Building / Construction Components: Meet or exceed established standards.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original unopened packaging fully identified as to manufacturer, brand or other identifying data as approved in submittal documents.
- B. Store materials under cover, and in a dry location until ready for installation. Roofing insulation must always be covered or stored in a dry area when not being used.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload the structure.
- D. Familiarize every member of the installation crew with the manufacturer's material safety data sheets and with fire and safety regulations recommended by OSHA, NRCA, and as required by governing codes of authorities having jurisdiction.

#### **1.7 PROJECT / SITE CONDITIONS**

- A. When air temperatures of 40 degrees F or above are predicted to occur within the first 24 hours after placement, normal application procedures may be used.
- B. When air temperatures of 32 degrees F - 40 degrees F are predicted to occur within the first 24 hours after placement, warm water not exceeding 90 degrees F may be used.
- C. Do not place the lightweight insulating concrete system when air temperatures are below 40 degrees F, including wind chill.
- D. Insulating Lightweight Concrete Fill Installer shall be responsible for protecting the new insulating lightweight concrete deck from all adverse conditions until roofing begins.

#### **1.8 SEQUENCING AND SCHEDULING**

- A. Sequence and coordinate application of lightweight insulating concrete roof insulation with work in other sections so as not to interfere with efficient roof insulation application.

#### **1.9 WARRANTY**

- A. Manufacturer's Warranty: Warrant the decking and associated Work in conjunction with the roofing manufacturer from the project date of Substantial Completion as follows:
  - 1. The warranty shall be a NDLC "No Dollar Limit" / no penal sum type, with total replacement cost. Refer to roof system specification section for length of warranty period.
  - 2. The warranty shall provide manufacturer's maximum extended wind rated coverage (up to Hurricane force winds) as defined by the Beaufort Scale.

3. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
  4. The full system warranty including lightweight insulating concrete deck, roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Contractor Warranty: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the lightweight insulating concrete deck will be and remain in good condition for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty.
- C. Make arrangements with the roofing manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 APPROVED MANUFACTURERS**

- A. Products and manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
1. Elastizell Corp. of America
  2. Siplast, Inc.
  3. Vermiculite Products Inc.
  4. Celcore, Inc.
  5. Mearlcrete

### **2.2 MATERIALS**

- A. Metal Deck: Refer to Section 05 31 00. Corrugated steel decking incorporating a pre-applied galvanized coating conforming to ASTM A653, minimum Class G-90 and having slots in flutes equal to a minimum of 0.75 percent of the deck area. Refer to Structural Drawings for size, type and section modulus of metal deck and for welding pattern of deck.
- B. Insulation Board:
1. Type: Expanded polystyrene (EPS) insulation board Type I by ASTM C578 and containing approximately three (3) percent open area.
  2. Thickness: 6 inches thick minimum, unless shown otherwise.
  3. Approved Products / Manufacturers:
    - a. "Insulperm" manufactured by Siplast, Irving, Texas (800) 922-8800.
    - b. "Starrfoam-HB" manufactured by Starrfoam Manufacturing, Inc., Fort Worth, Texas (817) 654-4688.
    - c. "Vermaperm" manufactured by Vermiculite Products Inc., Houston, Texas (713) 869-6663.
    - d. "Holey Board" manufactured by Houston Foam Plastics, Houston, Texas, (713) 224-3612.
    - e. PowerFoam, manufactured by PowerFoam, Midolathian Texas 972-299-5556

- C. Water: Potable water that is clean and free of deleterious amounts of acid, alkali, and organic materials – (Drinkable).
- D. Cement: Portland type, conforming to ASTM C150, Type I or III.
- E. Foam Concentrate: Protein based foam concentrate conforming to ASTM C 869 and ASTM C 796.
- F. Vermiculite Aggregate: Any one (1) of the following products from a single manufacturer is approved for use on this Project:
  - 1. Vermiculite: Comply with ASTM C332, produced by a current member of VA. Mix shall be 1:6 with 350 (min) psi at 28 days compressive strength; 48 to 60 pcf wet density, and 25 to 32 pcf dry density.
  - 2. Cellular: Mix shall be 1:3 with minimum compressive strength of 350 psi, cast density of 34-42 pcf, manufactured by Elastizell Corporation of America, Ann Arbor, MI (734) 761-6900\
- G. Admixtures: Air entraining types and superplasticizer (water reducer) types as recommended by insulating concrete material manufacturer. Admixtures may be injected into material at the plant. The use of calcium chloride is not permitted.
- H. Expansion Joint Material: One (1) inch thick of type recommended by insulating concrete material supplier for expansion joints in structural system.
- I. Reinforcing: 3/4 inch long, polypropylene fiber, Fibermix as manufactured by Fibermesh Co. for cellular concrete only.
- J. Nailers: (Refer to Section 06 10 00, Rough Carpentry) As shown on drawings. Install required thickness of wood to align with specified thickness of lightweight insulating concrete.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Prior to placing reinforcing and insulating concrete, inspect to ensure all piping, curbs, wood nailers, etc., have been raised to the proper height and the substrate is free of any foreign materials.
- B. Ensure perimeter edge and penetrations are sealed in a watertight fashion.
- C. Ensure temporary roof is installed as specified in Section 07 52 19.

#### **3.2 PREPARATION**

- A. Notify other trades of dates of pouring in ample time for each to install his work.
- B. Review required finishes and allowable tolerances for surface defects.
- C. Set screeds so various deck thicknesses are maintained uniformly in place with all slopes as shown and detailed on drawings.
- D. Verify with the appropriate type instrument that all roof areas have positive drainage. Areas lacking positive drainage are unacceptable and shall be removed and re-poured at Contractor's expense.

### 3.3 INSTALLATION

- A. Metal Deck: Place sheets with corrugation edges upon the perpendicular to supports with end laps centered over supports. Attach to supports with plug welds through welding washers. Refer to Structural Drawings for additional requirements.
- B. Expansion Joint Material: Install at the following locations.
  - 1. Perimeter of deck.
  - 2. Changes in direction of roof deck.
  - 3. Structural roof penetrations and expansion joints
- C. Provide equipment and installation procedures conforming to the materials manufacturer's installation instructions.
- D. Mix Portland cement and aggregate in a mix ratio design with water in accordance with manufacturer's instructions to achieve the specified wet density, minimum dry density, and minimum compressive strength.
- E. Install slurry coat of lightweight insulating concrete over metal deck to minimum thickness of 1/4 inch over top of flutes of metal decking.
- F. Place insulation boards into slurry within 30 minutes of applying lightweight insulating concrete in accordance with manufacturer's instructions.
- G. Place insulation board with joints staggered in a brick-like running bond pattern.
- H. Hold board back two (2) inches from the perimeter of the roof areas and all roof top units.
- I. Butt boards together and place so as to provide full contact of slurry with board, causing insulating concrete fill to enter the locking/keying openings in the insulation board.
- J. Walk insulation board into slurry to ensure proper embedding of insulation boards into lightweight insulating concrete and keying with insulation holes.
- K. Fill holes in the insulation boards and place a two (2) inch minimum thickness of lightweight insulating concrete over top of the insulation boards within four (4) hours after installation of insulation boards.
- L. Build all crickets and saddles shown with lightweight insulating concrete sloped to drain as indicated on drawings.
- M. Deposit insulating concrete fill and screed (without troweling, rodding, tamping, or vibrating) immediately after mixing. Place on surfaces clean and free of loose material. Place no concrete when temperature is 40 degrees F or falling.
- N. All wood blocking for deck penetrations support and low roof deck to rise wall blocking shall be installed one (1) inch higher than designed lightweight fill thickness. Install fill in a two (2) foot tapered edge condition.
- O. Allow insulating concrete fill to dry as thoroughly as possible before application of roofing, and not less than the minimum time recommended by the manufacturer. Begin roofing when the insulating concrete fill can withstand construction traffic (usually two (2) to three (3) days after placement), verify / confirm with manufacturer's recommendations. Do not leave insulating concrete fill deck surface exposed for longer than ten (10) days. Install no more insulating concrete fill than can be roofed within the ten (10) day time limit. Maximum unroofed insulating concrete deck shall be 5,000 square feet; no exceptions.

- P. Where material is to be pumped, equipment shall be in good condition and well maintained to avoid equipment failure and delays.
- Q. Install and cure lightweight insulating concrete in accordance with manufacturer's instructions.
- R. Avoid roof-top traffic over the lightweight insulating concrete deck system until 24 hours have elapsed after last placement of lightweight insulating concrete.
- S. Allow lightweight insulating concrete to dry as thoroughly as possible before application of roofing. Testing Laboratory may perform tests to determine moisture content of lightweight insulating concrete.
- T. Add two (2) pounds of fiber reinforcing per cubic yard of lightweight insulating concrete if cellular concrete is used.

### **3.4 FIELD QUALITY ASSURANCE**

- A. The Owner will select the independent inspection and testing laboratory and pay for the cost of tests in accordance with Division 1.
- B. The independent inspection and testing laboratory will randomly sample and verify the following:
  - 1. Thermal insulation value in accordance with ASTM C177.
  - 2. Mix design compressive strength in accordance with ASTM C495.
  - 3. Mix design wet and dry density range in accordance with ASTM C495.
  - 4. Polystyrene insulation density in accordance with ASTM C578.
- C. Contractor shall provide base ply fastener pull tests prior to installation of roofing system, following the installation of the lightweight insulating concrete to ensure a minimum withdrawal resistance of 40 pounds per fastener.
- D. Results of all tests will be made available to all concerned parties.
- E. Water Test: Run water on the finished deck for the Architect's observation. The lightweight insulating concrete shall slope to drain and no ponding of water will be accepted. No slopes less than 1/4 inch per foot will be allowed.
- F. Certification: On completion of installation, furnish Architect with certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.

### **3.5 ADJUSTING AND CLEANING**

- A. Remove ridges, surface depressions and other surface irregularities which are unacceptable to the roofing contractor and Architect.
- B. Completely remove all insulating concrete fill from any surface on which it is not intended to be placed.
- C. Perform all patching and repairing of insulating concrete using Zono-Patch or other materials approved by the lightweight insulating concrete supplier.

### **3.6 PATCHING AND REPAIRING**



- A. Perform all patching and repairing of lightweight insulating concrete using the same materials specified in this Section or materials approved by the system manufacturer.
- B. The party responsible for damage will be charged for repairs.

**3.7 PROTECTION**

- A. Lightweight insulating concrete installer shall be responsible for protecting newly applied decks from all adverse conditions until Roofing Contractor begins installation of specified roof system.
- B. General Contractor shall be responsible for protection of roof deck from other trades until it has been approved for traffic by installer.

**END OF SECTION**

## **SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Liquid-applied self-leveling floor underlayment for resilient tile installation.
  - 1. Use hydraulic cement underlayment for application below interior floor coverings.

#### **1.02 REFERENCE STANDARDS**

- A. ASTM F710 - "Standard Practice for Preparing Concrete Floors To Receive Resilient Flooring".
- B. ASTM C1708 - "Standard Test Method for Self-Leveling Mortars Containing Hydraulic Cements".
- C. ASTM F2170 - "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes".
- D. ASTM F1869 - "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".
- E. ASTM C150 - "Standard Specification for Portland Cement".

#### **1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Environmental Product Declaration (EPD).
- D. Independent Laboratory Test Report: ASTM C1708 / C1708M-16.

#### **1.04 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store all products indoors in original unopened packaging. Keep all materials dry and away from direct sun exposure in moderate conditions between temperatures of 50 °F to 90 °F (10 °C to 32 °C).

#### **1.06 MOCK-UP**

- A. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Prepare mock-up in location designated by Architect.
  - 2. Area: 6 ft by 6 ft (2 m by 2 m).
- B. Mock-up may remain as part of the Work.

#### **1.07 FIELD CONDITIONS**

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F (10 degrees C) 24 hours before, during and 72 hours after installation of underlayment.

#### **1.08 WARRANTY**

- A. Provide minimum 10 year manufacturer system warranty for LVT installation utilizing all products required per the manufacturer to achieve. Basis of design warranty to be Uzin Utz Classic + 10 warranty.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURER**

- A. Basis of Design : Uzin Utz North America, Inc.
- B. Mapei
- C. Sika USA
- D. Or approved equal (submitted for review during bid process)

## 2.02 MATERIALS

- A. **Basis of Design** Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce a self-leveling underlayment.
  - 1. UZIN NC 150
    - Compressive Strength: Minimum 4500 psi (31.03 MPa) after 28 days, tested per ASTM C1708.
    - Flexural Strength: Minimum 900 psi (6.21 MPa) after 28 days, tested per ASTM C1708.
    - Thickness: Capable of thicknesses from 1/16" (1.5 mm) to maximum 1" (25mm).
  - 2. UZIN NC 157
    - Compressive Strength: Minimum 6000 psi (41.37 MPa) after 28 days, tested per ASTM C1708.
    - Flexural Strength: Minimum 1100 psi (7.58 MPa) after 28 days, tested per ASTM C1708.
    - Thickness: Capable of thicknesses from 1/4" (6 mm) to maximum 2" (50 mm).
  - 3. UZIN NC 170
    - Compressive Strength: Minimum 6000 psi (41.37 MPa) after 28 days, tested per ASTM C1708.
    - Flexural Strength: Minimum 1000 psi (6.89 MPa) after 28 days, tested per ASTM C1708.
    - Thickness: Capable of thicknesses from 1/16" (1.5 mm) to maximum NO DEPTH LIMITATION
  - 4. UZIN NC 172
    - Compressive Strength: Minimum 8000 psi (55.16 MPa) after 28 days, tested per ASTM C1708. (24-hour compressive strength of 4500 psi (31.03 MPa).)
    - Flexural Strength: Minimum 1800 psi (12.41 MPa) after 28 days, tested per ASTM C1708.
    - Thickness: Capable of thicknesses from 1/16" (1.5 mm) to maximum NO DEPTH LIMITATION
  - 5. UZIN NC 144 LW
    - Compressive Strength: Minimum 3000 psi (20.68 MPa) after 28 days, tested per ASTM C1708.
    - Flexural Strength: Minimum 600 psi (4.14 MPa) after 28 days, tested per ASTM C1708.
    - Thickness: Capable of thicknesses from 1/4" (6 mm) to maximum 2" (50 mm).
    - Lightweight: Dry Density of 67.0 ±2 lbs./ft<sup>3</sup> (1.40 lbs./ft<sup>2</sup> at 1/4").
- B. Low Emitting
  - 1. VOC content: 0g/L. Compliant with SCAQMD rule 1113.
  - 2. Certified: SCS Indoor Advantage Gold
- C. Water: Potable and not detrimental to underlayment mix materials.

## 2.02 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Mix to self-leveling consistency without over-watering.

HYDRAULIC CEMENT UNDERLAYMENT  
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### 2.03 ACCESSORIES

- A. Primer:
  - 1. Gypsum Concrete: Two coat application of UZIN PE 260 Primer (diluted to absorbency requirement to seal substrate).
  - 2. Standard Absorbent Concrete: UZIN PE 260 Primer (diluted to absorbency requirement to seal substrate).
  - 3. Extremely Absorbent Concrete: Two coat application of UZIN PE 260 Primer (diluted to absorbency requirement to seal substrate).
  - 4. Wood: UZIN PE 260 Primer (undiluted).
  - 5. Metal: UZIN PE 414 or PE 460 (seek technical guidance before proceeding).
  - 6. Other Non-Porous Substrates: UZIN PE 280 Primer.
- B. Joint Filler:
  - 1. Low-odor, 2-component, semi-rigid, polyurea joint filler: UZIN KR 518.
- C. Reinforcing Fibers: Can be used to improve impact resistance and control shrinkage of any UZIN self-leveling compound when used on demanding surfaces. Reduces cracking of the leveling compound when used on unsound substrates.
  - 1. Substrate Reinforcing Fibers – UZIN Bagged Fiber.
  - 2. Substrate Reinforcing Mesh (Sheets) – UZIN RR 201.
- D. Adhesive:
  - 1. Provide UZIN adhesive as required to achieve system warranty based on final system products needed to achieve the noted installation warranty type.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.
- B. Moisture Testing: Perform testing according to ASTM F2170. Provide 3 tests for the first 1,000 sq.ft. of floor area plus 1 additional test for each 1,000 sq.ft. thereafter.
  - 1. Relative Humidity Test: Using in situ probes, follow ASTM F2170. Proceed with installation only if the substrate is within spec of the underlayment, adhesive, and finished floor covering manufacturers' limitations.
  - 2. For concrete substrates with high residual moisture, notify owner, owner's rep and manufacturer for recommended preparation to achieve system installation warranty

### 3.02 PREPARATION

- A. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- B. Vacuum clean surfaces.
- C. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- D. Close floor openings.

### 3.03 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions. Always refer to the most current product information at [us.uzin.com](http://us.uzin.com).
- B. Pump or pour material onto substrate. Do not retemper or add water.
  - 1. Pump, move, and screed while the material is still highly flowable.
  - 2. Be careful not to create cold joints.
  - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).
- D. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

### 3.04 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.

HYDRAULIC CEMENT UNDERLAYMENT

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**3.05 PROTECTION**

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

**END OF SECTION**

## **SECTION 04 01 20 – MAINTENANCE OF UNIT MASONRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes maintenance of unit masonry in the area where demolition Work is adjacent to the existing masonry building.
  - 1. Repairing unit masonry, including replacing units.
  - 2. Reanchoring veneers.
  - 3. Repointing joints.
  - 4. Cleaning exposed unit masonry surfaces.

#### **1.3 DEFINITIONS**

- A. Very Low Pressure Spray: Under 100 psi (690 kPa).
- B. Low Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product, including material descriptions and application instructions and test data substantiating that products comply with requirements.
- B. Shop Drawings: For the following:
  - 1. Provisions for expansion joints or other sealant joints.
  - 2. Replacement and repair anchors. Include details of anchors within individual masonry unites, with locations of anchors and dimensions of holes and recesses in units required for anchors.
  - 3. Field investigation report outlining Work required after existing construction is removed from masonry surface.
- C. Samples for Initial Selection: For the following:
  - 1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches (150 mm) long

#### **1.5 QUALITY ASSURANCE**

- A. Paint Remover Manufacturer Qualifications: Firm having minimum 5 years documented experience who regularly engages in producing masonry cleaners, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and on site assistance.
- B. Chemical Cleaner Manufacturer Qualifications: Firm having minimum 5 years documented experience who regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and on site assistance.
- C. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding

materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.

1. If materials and methods other than those indicated are proposed for any phase of cleaning Work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.
- D. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) each type of masonry and surface condition.
    - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- E. Preconstruction Testing Service: Engage one or more chemical cleaner **[and paint remover]** manufacturers to perform preconstruction testing on masonry surfaces.
1. Use test areas as indicated and representative of proposed materials and existing construction.
  2. Propose changes to materials and methods to suit.
- F. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
    - a. Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
    - b. Materials, material application, and sequencing.
    - c. Cleaning program.
    - d. Coordination with building occupants.

## 1.6 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform masonry cleaning Work in the following sequence:
1. Remove plant growth.
  2. Inspect for open mortar joints. Where repairs are required, delay further cleaning Work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
  3. Remove paint.
  4. Clean masonry surfaces.
  5. Where water repellents are to be used on or near masonry, delay application of chemicals until after cleaning.

## 1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation when existing and forecasted weather conditions permit masonry cleaning Work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 degrees F (4 degrees C) and above and is predicted to remain so for at least seven days after completion of cleaning.

## **PART 2 - PRODUCTS**

### **2.1 CLEANING MATERIALS**

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 degrees F to 160 degrees F (60 degrees C. to 71 degrees C).
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.
- D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.
- E. Nonacidic Gel Cleaner: Gel formulation, with pH between 6 and 9 that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. PROSOCO, Inc.
    - b. AHI Supply Co.
- F. Nonacidic Liquid Cleaner: Mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Building Restoration Products, Inc.
    - b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - c. PROSOCO, Inc.
    - d. AHI Supply Co.
- G. Mild Acid Cleaner: Mild acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Building Restoration Products, Inc.
    - b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - c. PROSOCO, Inc.
    - d. AHI Supply Co.
- H. Acidic Cleaner: Acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Building Restoration Products, Inc.
    - b. PROSOCO, Inc.
    - c. AHI Supply Co.
- I. One Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Building Restoration Products, Inc.
    - b. PROSOCO, Inc.



- c. AHI Supply Co.
  
- J. Two Part Chemical Cleaner: System consisting of potassium- or sodium hydroxide based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - b. PROSOCO, Inc.
    - c. AHI Supply Co.

## 2.2 ACCESSORY MATERIALS

- A. Liquid Strippable Masking Agent: Liquid, film forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Building Restoration Products, Inc.
    - b. Price Research, Ltd.
    - c. PROSOCO, Inc.

## 2.3 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical cleaner manufacturer.
  
- B. Acidic Cleaner Solution for Nonglazed Masonry and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.
  - 1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.
  
- C. Acidic Cleaner for Glazed Masonry and Polished Stone: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.
  - 1. Stones: Use only on polished granite and polished dolomite marble.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by contact.
  - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
  - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
  - 3. Neutralize alkaline and acid wastes before disposal.

4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and/or downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
  1. Provide temporary rain drainage during Work to direct water away from building.

### **3.2 CLEANING MASONRY**

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.
- B. Proceed with cleaning working from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use cleaning methods indicated for each masonry material and location.
  1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
  2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
    - a. Equip units with pressure gages.
    - b. For chemical cleaner spray application, use low pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone shaped spray.
    - c. For water spray application, use fan shaped spray that disperses water at an angle of 25 to 50 degrees.
    - d. For high pressure water spray application, use fan shaped spray that disperses water at an angle of at least 40 degrees.
    - e. For heated water spray application, use equipment capable of maintaining temperature between 140 degrees F. and 160 degrees F (60 degrees C and 71 degrees C) at flow rates indicated.
    - f. For steam application, use steam generator capable of delivering live steam at nozzle.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed, so cleaned surfaces blend smoothly into surrounding areas.
- F. Water Application Methods:
  1. Water Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
  2. Water Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches (150 mm) from masonry surface and apply

steam in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

- H. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
  - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

### **3.3 PRELIMINARY CLEANING**

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
  - 1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
  - 2. Remove paint and calking with alkaline paint remover.
    - a. Comply with requirements.
    - b. Repeat application up to two times if needed.
  - 3. Remove asphalt and tar with solvent type paste paint remover.
    - a. Comply with requirements.
    - b. Apply paint remover only to asphalt and tar by brush without prewetting.
    - c. Allow paint remover to remain on surface for 10 to 30 minutes.
    - d. Repeat application if needed.

### **3.4 CLEANING MASONRY**

- A. Cold Water Soak:
  - 1. Apply cold water by intermittent spraying to keep surface moist.
  - 2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
  - 3. Apply water in cycles of five minutes on and 20 minutes off.
  - 4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests.
- B. Cold Water Wash: Use cold water applied by low, medium, or high pressure spray.
- C. Hot Water Wash: Use hot water applied by low, medium, or high pressure spray.
- D. Steam Cleaning: Apply steam at very low pressures not exceeding 80 psi (550 kPa). Remove dirt softened by steam with wood scrapers, stiff nylon or fiber brushes, or cold water wash, as indicated by cleaning tests.
- E. Detergent Cleaning:

1. Wet surface with water applied by low pressure spray.
  2. Scrub surface with detergent solution using medium soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
  3. Rinse with water applied by high pressure spray to remove detergent solution and soil.
  4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- F. Mold, Mildew, and Algae Removal:
1. Wet surface with water applied by low pressure spray.
  2. Apply mold, mildew, and algae remover by brush.
  3. Scrub surface with medium soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
  4. Rinse with cold water applied by medium pressure spray to remove mold, mildew, and algae remover and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- G. Nonacidic Gel Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
  2. Apply gel cleaner in 1/8 inch (3 mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Remove bulk of gel cleaner.
  5. Rinse with water applied by low pressure spray to remove chemicals and soil.
  6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- H. Nonacidic Liquid Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
  2. Apply cleaner to surface in two applications by brush or low pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- I. Mild Acid Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
  2. Apply cleaner to surface in two applications by brush or low pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Rinse with cold water applied by medium -pressure spray to remove chemicals and soil.
  5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- J. Acidic Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
  2. Apply cleaner to surface in two applications by brush or low pressure spray.

3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
- K. One Part Limestone Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
  2. Apply cleaner to surface by brush or low pressure spray.
  3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
  4. Immediately repeat application of one part limestone cleaner as indicated above over the same area.
  5. Rinse with water applied by medium pressure spray to remove chemicals and soil.
- L. Two Part Chemical Cleaning:
1. Wet surface with hot water applied by low pressure spray.
  2. Apply alkaline prewash cleaner to surface by brush or roller.
  3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer unless otherwise indicated.
  4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
  5. Apply acidic afterwash cleaner to surface in two applications, while surface is still wet, using low pressure spray equipment, deep nap roller or soft fiber brush. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
  6. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
  7. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer Field Service: Engage paint remover manufacturer's and chemical cleaner manufacturer factory authorized service representatives for consultation and Project site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Architect. Have paint remover manufacturer and chemical cleaner manufacturer factory authorized service representatives visit site not less than once to observing progress and quality of the Work.

### **3.6 FINAL CLEANING**

- A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

**END OF SECTION 04 01 20**

## **SECTION 04 05 00 - COMMON WORK RESULTS FOR MASONRY**

### **PART 1 GENERAL**

#### **1.1 GENERAL REQUIREMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Mortar and grout for masonry assemblies.
  - 2. Ties and anchors.
  - 3. Embedded flashing.
  - 4. Penetrating water repellents.
  - 5. Miscellaneous masonry accessories.
  - 6. Cleaning exposed unit masonry surfaces.

#### **1.3 REFERENCE STANDARDS:**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- E. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- G. ASTM B32 - Standard Specification for Solder Metal; 2020.
- H. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.
- I. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- J. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- K. ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement; Current Edition.
- L. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- M. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- N. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- O. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- P. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
- Q. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- R. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- S. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.

- T. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- U. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
- V. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber; 2020.
- W. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
- X. ASTM D2287 - Standard Classification System and Basis for Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; Current Edition.
- Y. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

#### **1.4 DEFINITIONS**

- A. Very Low Pressure Spray: Under 100 psi (690 kPa).
- B. Low Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

#### **1.5 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Mix design for mortar and grout shall be submitted for review.
- C. Supplier's certificates indicating materials comply with the specifications below. They shall include, but are not necessarily limited to:
  - 1. Aggregates.
  - 2. Cement.
  - 3. Admixtures.
- D. Shop Drawings:
  - 1. For the following:
    - a. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- E. Samples for Initial Selection:
  - 1. Colored mortar.
  - 2. Weep holes/vents.
- F. Samples for Verifications:
  - 1. For each type and color of the following:
    - a. Pigmented and colored-aggregate mortar. Make samples using same sand and mortar ingredients to be used on Project.
    - b. Weep holes and vents.
    - c. Accessories embedded in masonry.
- G. Material Certificates:
  - 1. For each type and size of the following:
    - a. Cementitious materials. Include brand, type, and name of manufacturer.
    - b. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
    - c. Grout mixes. Include description of type and proportions of ingredients.
    - d. Anchors, ties, and metal accessories.
- H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- B. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination.
- C. Tests and Inspections:
  - 1. All tests and inspections herein are to be performed by an independent testing laboratory approved by the building official.
  - 2. Mortar and grout tests:
    - a. At the beginning of masonry work, at least one (1) test sample each of mortar and grout shall be taken on three (3) successive working days, then once per week with at least one sample taken for each 5,000 square feet of wall area, or fraction thereof:
      - 1) Test specimens shall be made in accordance with ASTM C1019 for grout and ASTM C780 for mortar.
      - 2) Test specimens shall be continuously stored in moist air until tested.
      - 3) Mortar shall show a compressive strength of not less than 1,800 psi at 28 days. Grout shall show a compressive strength of not less than 2,000 psi at 28 days.
- D. Paint Remover Manufacturer Qualifications: Firm having minimum five (5) years' documented experience who regularly engages in producing masonry cleaners, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- E. Chemical Cleaner Manufacturer Qualifications: Firm having minimum five (5) years' documented experience who is regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- F. Cleaning Program:
  - 1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
    - a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.
- G. Pre-Installation Conference:
  - 1. Conduct conference at Project site:
    - a. Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
    - b. Materials, material application, and sequencing.
    - c. Cleaning program.
    - d. Coordination with building occupants.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.



- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## **PART 2 PRODUCTS**

### **2.1 MORTAR AND GROUT MATERIALS**

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type N or S as indicated in masonry section.
- C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime, complying with specified requirements and containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
- E. Quicklime: ASTM C5.
- F. Lime Putty:
  - 1. Made from hydrated lime or quicklime:
    - a. If made from quicklime, other than processed pulverized quicklime, slake lime and then screen through a No. 16 mesh sieve. Before using, store and protect slaked and screened lime putty for not less than 10 days.
    - b. Processed pulverized quicklime shall be slaked for not less than 48 hours, and shall be cool when used.
    - c. Lime putty prepared from hydrated lime may be used immediately after mixing.
    - d. Lime putty prepared from quicklime or pulverized quicklime shall have a plasticity figure, after slaking and screening, of not less than 200, and shall weigh not less than 83 pounds per cubic foot. Lime putty prepared from hydrated lime shall conform to ASTM C207, Type S.
- G. Aggregate:
  - 1. For mortar: ASTM C144.
  - 2. For grout: ASTM C404.
- H. Admixtures:
  - 1. Cold Weather Admixture:
    - a. Non-chloride, non-corrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated:
      - 1) Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
        - (a) BASF Corporation.
        - (b) Euclid Chemical.
        - (c) GCP Applied Technologies.
      - 2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- I. Water: Potable.

### **2.2 MORTAR MIXES**

- A. General:
  - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated:
    - a. Do not use calcium chloride in mortar.
    - b. Use masonry cement or mortar cement mortar unless otherwise indicated.

- c. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-Blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
  1. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide Type S or Type N as indicated in related Section.
  1. Type S mortar shall have a 28 day compressive strength of not less than 1,800 psi.
- D. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions.
- E. Mortar mix shall be proportioned by volume; one-part portland cement, not less than 1/4-part nor more than 1/2-part lime putty, and sand totaling not less than 2-1/4 nor more than three (3) times sum of volumes of cement and lime used:
  1. Total clay content shall not exceed 2 percent of sand content or six percent 6 percent of cement content.

### 2.3 GROUT MIXES

- A. Grout for Unit Masonry: Comply with ASTM C476.
  1. Grout shall have a 28-day compressive strength of not less than 2,000 psi (14 MPa). Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
  2. Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
- B. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that complies with TMS 402/602 for dimensions of grout spaces and pour height.
  1. Fine Grout:
    - a. One-part portland cement, to which may be added not more than 1/10 part lime putty, and three-parts sand.
    - b. Fine grout shall be used for all grout spaces less than 3 inches wide.
  2. Coarse Grout:
    - a. One-part portland cement, to which may be added not more than 1/10 part lime putty, three-parts sand, and not less than one-part nor more than two-parts pea gravel (3/8 inch maximum aggregate size).
    - b. Coarse grout shall be used in grout spaces 3 inches wide or more.
- C. Grout Additive:

### 2.4 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A951/A951M.
  1. Masonry joint reinforcement used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B, minimum coating of 1.5 ounce for square foot.
- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch diameter, hot-dip galvanized, carbon-steel continuous wire.
- C. Reinforcing Bars:
  1. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- D. Reinforcing Bar Positioners:

1. Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Form units from 0.148 inch (3.77 mm) steel wire, hot dip galvanized after fabrication. Provide units designed for number of bars indicated:
2. Manufacturers:
  - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
    - 1) Heckmann Building Products, Inc.
    - 2) Hohmann & Barnard, Inc.
    - 3) Wire-Bond.

## 2.5 TIES AND ANCHORS

- A. General:
  1. Sheet Metal Anchors and Ties - ASTM A1008/A1008M:
    - a. Sheet metal anchors and ties used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B.

## 2.6 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034 inch galvanized steel sheet.

## 2.7 EMBEDDED FLASHING MATERIALS

- A. Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and/or Section 07 62 00 - Roof Related Sheet Metal and as follows:
  1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch thick.
  2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16 ounces per square foot weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12 ounces per square foot weight or 0.0162 inch thick.
  3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  4. Fabricate through-wall metal flashing embedded in masonry from copper, with ribs at 3 inch intervals along length of flashing to provide an integral mortar bond:
    - a. Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cheney Flashing Company: Cheney Flashing (Dovetail).
      - 2) Keystone Flashing Company, Inc: Keystone 3-Way Thruwall Flashing.
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
  6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
  9. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

10. Metal sealant stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  11. Metal expansion-joint strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing:
1. Use one of the following unless otherwise indicated:
    - a. Copper-Laminated Flashing: 5 ounces per square foot copper sheet bonded between two (2) layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry:
      - 1) Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
        - (a) Hohmann & Barnard, Inc.
        - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
      - b. Asphalt-Coated Copper Flashing: 7 ounces per square foot copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry:
        - 1) Products are subject to compliance with requirements; available products that may be incorporated into the Work include, but are not limited to, the following:
          - (a) Advanced Building Products Inc.
          - (b) Hohmann & Barnard, Inc.
          - (c) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
        - 2) Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application:
1. Unless otherwise indicated, use the following:
    - a. Where flashing is indicated to receive counterflashing, use metal flashing.
    - b. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
    - c. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge with a sealant stop or flexible flashing with a metal sealant stop.
    - d. Where flashing is fully concealed, use flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings:
1. Solder for stainless steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
  2. Solder for copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.8 LIQUID SURFACE TREATMENTS

- A. Penetrating Water Repellent:
1. Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components, odorless, that penetrates, hardens, and densifies concrete surfaces:
  2. Manufacturers:
    - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
      - 1) Moxie International Inc.
    - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures .
  3. Basis of Design: Moxie Shield 1400 Surface Sealer or Moxie Shield Shield 1300 Brick Sealer as manufactured by Moxie International Inc.

## 2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane.
- B. Preformed Control Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products - Use one of the following unless otherwise indicated:
- E. Cavity Drainage Material:
  - 1. Free draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  - 4. Configuration:
    - a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

## 2.10 CLEANING MATERIALS (VERIFY WITH LOCAL ORDINANCE)

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 degrees F to 160 degrees F (60 degrees C to 71 degrees C).
- C. Detergent Solution - Job Mixed: Solution prepared by mixing two cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every five gallons (20 L) of solution required.
- D. Mold, Mildew, and Algae Remover - Job Mixed: Solution prepared by mixing two cups (0.5 L) of tetrasodium pyrophosphate (TSPP), five quarts (5 L) of five percent (5%) sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every five gallons (20 L) of solution required.
- E. Non-Acidic Gel Cleaner:
  - 1. Gel formulation, with pH between six (6) and nine (9) that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces:
  - 2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
  - 3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- F. Non-Acidic Liquid Cleaner:
  - 1. Mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood:
  - 2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5)

- years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
- a. AHI Supply Co.
  - b. Diedrich Technologies, Inc.
  - c. PROSOCO, Inc.
3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- G. Mild acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches:
1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply, Inc.
    - b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - c. PROSOCO, Inc.
  2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- H. Acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors:
1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply Co.
    - b. American Building Restoration Products, Inc.
    - c. PROSOCO, Inc.
  2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- I. Two-part chemical cleaner system consisting of potassium - or sodium hydroxide based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid:
1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. AHI Supply Co.
    - b. Diedrich Technologies, Inc.
    - c. PROSOCO, Inc.
  2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## **2.11 CHEMICAL CLEANING SOLUTIONS**

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical cleaner manufacturer.
- B. Acidic Cleaner Solution for Non-Glazed Masonry and Unpolished Stone:
1. Dilute acidic cleaner with water to produce hydrofluoric acid content of three percent (3%) or less, but not greater than that recommended in writing by chemical-cleaner manufacturer:
    - a. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.
- C. Acidic Cleaner for Galzed Masonry Glazed Masonry and Polished Stone:
1. Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch, or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer:

- a. Stones: Use only on polished granite and polished dolomite marble.

## 2.12 MASKING MATERIALS

- A. Liquid Strippable Masking Agent:
  1. Liquid, film forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners:
  2. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered:
    - a. American Building Restoration Products, Inc.
    - b. Price Research, Ltd.
    - c. PROSOCO, Inc.
  3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## PART 3 EXECUTION

### 3.1 PROJECT CONDITIONS

- A. Protection of Masonry:
  1. During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress:
    - a. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
    - b. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Stain Prevention:
  1. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry:
    - a. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
    - b. Protect sills, ledges, and projections from mortar droppings.
    - c. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
    - d. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements:
  1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602:
    - a. Cold-weather cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

### 3.2 COORDINATION

- A. Build openings and chases for heating, plumbing, electrical ducts, pipes, and conduits into masonry walls as necessary. Install bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as necessary:

1. Coordinate related work incorporating installation of work to prevent subsequent cutting and patching.
2. Coordinate installation of steel reinforcement for reinforced masonry.
3. Coordinate dampproofing, waterproofing, and air infiltration membrane activities with masonry construction.
4. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

### **3.3 EXAMINATION**

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work:
  1. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the work.
  2. Verify foundations are within tolerances specified.
  3. Verify reinforcing dowels are properly placed.
  4. Verify substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation after correcting unsatisfactory conditions.

### **3.4 MORTAR AND GROUT**

- A. Mixing Mortar and Grout
  1. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable. Each 94 pound sack of Portland cement will be considered as 1 cubic foot.
  2. Place sand, cement, and water in mixer, in that order, and mix for at least 2 minutes. Add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.
  3. Use mixers of at least 01 sack capacity; batches requiring fractional sacks will not be permitted unless cement is weighed for each batch.
- B. Grouting Procedures
  1. As specified in Related Section(s).
- C. Retempering
  1. When necessary to retemper mortar, add water and remix; retempering by dashing water over mortar will not be permitted.
  2. Any mortar that is unused within 30 minutes after initial mixing and any mortar that has begun to set shall not be used.
- D. Defective Mortar or Grout
  1. Should the strength of mortar or grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and mortar and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
  2. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to Owner.
  3. Costs relative to taking and testing of core samples shall be paid by Owner and will be deducted from Contract amount. Cost of patching core holes shall be borne by Contractor.

### **3.5 INSTALLATION, GENERAL**

- A. Construct masonry veneer in compliance with TMS 402/602.
- B. Thickness: Build single wythe walls to actual widths of masonry units, using units of widths indicated.
- C. Build chases and recesses to accommodate items specified in this and other Sections.



- D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures:
  - 1. Mix units from several pallets or cubes as they are placed.
- G. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- H. All masonry shall be laid true, level, plumb, and as indicated on Drawings.

### 3.6 TOLERANCES, GENERAL

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
  - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  - 2. For exposed bed joints, do not vary from bed joint thickness of adjacent courses by more than 1/8 inch (3 mm).
  - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
  - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
  - 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### **3.7 LAYING MASONRY, GENERAL REQUIREMENTS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond. Do not use units with less than nominal 4 inch (100 mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill all cores in hollow CMU with grout.

### **3.8 MORTAR BEDDING AND JOINTING**

- A. Lay masonry units as indicated in appropriate Section.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

### **3.9 MASONRY JOINT REINFORCEMENT**

- A. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond opening in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T shaped units.
- D. Provide continuity at corners by using prefabricated L shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### **3.10 ANCHORED VENEERS**

- A. Ties and Anchors: Extend ties and anchors a minimum 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16 mm) cover on outside face.
- B. Provide not less than 1/2 inch of airspace between back of masonry veneer and face of masonry:

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### **3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE**

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
  1. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  2. Anchor masonry with anchors embedded in masonry joints and attached to structure. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.
  3. Anchor masonry with anchors embedded in masonry joints and attached to structure.
- B. Anchor veneers to concrete masonry backup with masonry anchor ties and veneer ties as indicated on the Drawings. Comply with the following requirements:
  1. Embed anchor ties in masonry joints as indicated on Drawings.
  2. Fasten veneer ties to masonry backup through loops of anchor ties projecting from masonry surface.
  3. Space anchors ties as indicated, but not more than 12 inches o.c. vertically and 12 inches o.c. horizontally, with not less than one (1) anchor for each 1 square foot of wall area. Install additional anchors at openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

### **3.12 ANCHORING MASONRY VENEERS**

- A. Anchor masonry veneers to wall framing and concrete backup with seismic masonry-veneer anchors to comply with the following requirements:
  1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two (2) fasteners unless anchor design only uses one (1) fastener.
  2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one (1) anchor at each stud in each horizontal joint between sheathing boards.
  3. BIA Technical Notes 28B recommends 2 inches (50 mm) of air space. Wider air spaces require closer tie spacing.
  4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  5. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one (1) anchor for each 2 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
  6. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than one (1) anchor for each 3-1/2 square feet of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

### **3.13 CONTROL AND EXPANSION JOINTS**

- A. Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 - Joint Sealants, but not less than 3/8 inch:
  1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### **3.14 LINTELS**

- A. Provide steel lintels where indicated.

- B. Provide masonry lintels where shown and where openings of more than 24 inches (610 mm) for block size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

### **3.15 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS**

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
  - 1. Install flashing as follows unless otherwise indicated:
    - a. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
    - b. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
    - c. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
    - d. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant for application indicated.
    - e. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
    - f. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
  - 2. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- B. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  - 1. Use specified weep/vent products to form weep holes.
  - 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  - 3. Space weep holes 24 inches o.c. unless otherwise indicated.
  - 4. Retain last subparagraph above if weep holes other than plastic tubing or wicking are used. Retain first subparagraph below if plastic tubing or wicking is used.
  - 5. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
  - 6. Trim wicking material flush with outside face of wall after mortar has set.
- D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" article.
- F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents:
  - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### 3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections:
  - 1. Special inspections according to Level C in TMS 402/602:
    - a. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
    - b. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
    - c. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One (1) set of tests.
- D. Testing Frequency: One (1) set of tests for each 5,000 square feet (464 sq. m) of wall area or portion thereof.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

### 3.17 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs:
  - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
  - 2. For burnished, glazed, or pre-finished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge.
- D. Final Cleaning - After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. After mortar is thoroughly set and cured, clean exposed masonry:
    - a. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
    - b. Test cleaning methods on sample wall panel; leave 1/2 of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
    - c. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
    - d. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
    - e. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
    - f. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

- g. Do not use acids on concrete masonry units.
  - h. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
- E. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site:
- 1. Comply with Construction Waste Management plan.

**3.18 MASONRY WASTE DISPOSAL**

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

**3.19 WATER REPELLENT APPLICATION**

- A. Cleaning shall be complete and accepted by Architect, and wall surfaces shall be thoroughly dry prior to application.
- B. Apply water repellent in strict accordance with water repellent manufacturer's instructions.

**END OF SECTION 04 05 00**

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## **SECTION 04 20 00 - UNIT MASONRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Concrete masonry units (CMU)
- B. Face brick, including solids.

#### **1.3 DEFINITIONS**

- A. CMU: Concrete masonry unit.
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### **1.4 RELATED WORK**

- A. Section 01 45 23 - Testing and Inspecting Services.
- B. Section 05 50 00 – Metal Fabrications. Steel masonry lintels.
- C. Section 07 11 00 – Bituminous Dampproofing.
- D. Section 07 21 00 – Thermal Insulation.
- E. Section 07 92 00 – Joint Sealants.
- F. Section 09 90 00 – Painting and Coatings.
- G. All Sections of Work built-in, adjacent to, or applied to unit masonry work.

#### **1.5 REFERENCES**

- A. ASTM International (ASTM)
  - 1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron & Steel Hardware.
  - 2. A307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - 3. A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 4. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
  - 5. C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
  - 6. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
  - 7. C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
  - 8. C144 - Standard Specification for Aggregate for Masonry Mortar.
  - 9. C150, Standard Specification for Portland Cement.
  - 10. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
  - 11. C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).



12. C270 - Standard Specification for Mortar for Unit Masonry.
13. C331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
14. C332 - Standard Specification for Lightweight Aggregates for Insulating Concrete.
15. C404 - Standard Specification for Aggregates for Masonry Grout.
16. C476 - Standard Specification for Grout for Masonry.
17. C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
18. C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
19. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
20. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
21. D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
22. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
23. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. Underwriters' Laboratories, Inc. (UL)

## 1.6 QUALITY ASSURANCE

- A. Where requirements of this Section are in conflict with requirements noted on the Structural Drawings, the Structural Drawings shall take precedence. Refer to Structural Drawings for information on load-bearing CMU walls.
- B. Fire Performance Characteristics: Where indicated or required, provide materials and construction which are identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L. or other recognized testing and inspection organization or by other means, acceptable to authority having jurisdiction.
- C. Masonry Cleaning: Workers shall have minimum 5 years of masonry cleaning experience, and shall be approved by cleaner manufacturer prior to application of cleaning material, and shall meet with cleaner manufacturer for demonstration and instructions for use of product prior to application.
- D. Perimeter Walk-Around: Daily perimeter walk-around the exterior side of the masonry by the GC and or masonry Subcontractor at the end of each work day as a visual inspection looking for obvious issues or flaws concerning colors, finishes, workmanship, protection of Work.
- E. Single Source Responsibility:
  1. For Masonry Units: Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one (1) manufacturer for each different product required for each continuous surface or visually related surfaces.
  2. For Mortar and Grout Materials: Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work where exposed to view and where not scheduled to receive a subsequently applied finish, i.e. parging, painting, etc., unless directed otherwise in writing by the Architect.
  3. Contractor's Responsibility: Contractor performing Work of this Section shall be responsible for coordinating with others performing work which is built-in or adjacent to unit masonry work.

## 1.7 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Samples: Two (2) sets of color chips representing manufacturer's full range of available colors and textures of each face brick for Architect's selection and approval.
- C. Sample Panel(s):
  - 1. Do not start masonry until Architect has approved samples.
  - 2. Sample panel shall be 6 feet long by 8 feet high showing selected color range and texture, bonding, joint shape, and quality of workmanship. Include a brick and expansion joint, and any specialty details, such as reveals, soldier courses, etc. Include mock-up of installation of thru-wall flashing at foundation sill and lintel above openings, window jambs and sills.
  - 3. A separate panel for each type of masonry used is required.  
Sample panel(s) shall remain at the jobsite until all masonry is completed.  
Installed materials shall be visible and integrated into adjacent materials.
  - 4. Brace and support as required to withstand structural wind loads.
- D. Certification: Submit manufacturer's affidavit that materials used in Project contain no asbestos.
- E. Mortar and Grout Mix Designs: Submit two (2) copies of proposed mortar and grout mix designs to Owner's testing laboratory.

## 1.8 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

## 1.9 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Build mockups for typical exterior and interior walls in sizes approximately 72 inches (1800 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant filled joint at least 16 inches (400 mm) long in each mockup.
    - b. Include lower corner of window opening, framed with stone trim, at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
    - c. Include through wall flashing installed for a 24 inch (600 mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12 inch (300 mm) length of flashing left exposed to view (omit masonry above half of flashing).
    - d. Include metal studs, sheathing, water resistive barrier, sheathing joint and penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry veneer wall mockup.
    - e. Include each type of masonry on one face of interior unit masonry wall mockup.
  - 3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
  - 4. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  - 5. Protect accepted mockups from the elements with weather resistant membrane.

6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
  - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
  - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

#### **1.10 TESTS AND INSPECTIONS**

- A. Materials and installation of masonry shall be subject to testing and inspection by an independent testing laboratory. Such tests and inspections shall not relieve Contractor of responsibilities for providing materials and procedures which comply with Contract Documents. Promptly remove and replace materials which do not comply.
- B. Owner will select Inspection and Testing Laboratory and will pay for all Work required by Inspection and Testing Laboratory.

#### **1.11 DELIVERY, STORAGE AND PROTECTION**

- A. Deliver and store materials in dry protected areas off ground. Keep free of stain or other damage before, during and after installation. Replace any damaged material at no cost to Owner.
- B. During freezing weather, protect masonry units with tarpaulins or other suitable material. Keep free of stain or other damage before, during and after installation. Replace damaged material at no cost to Owner.
- C. Protect reinforcement and accessories from elements.

#### **1.12 SITE CONDITIONS**

- A. Cold Weather Protection:
  1. No masonry shall be laid when the temperature of the outside air is below 40 degrees F, unless protection measures are employed and pre-approved by the Architect.
  2. Protection measures for cold weather erection include maintaining space and masonry unit temperatures of at least 40 degrees F for 48 hours prior to and after erection.
- B. Hot Weather Protection:
  1. When the mean daily temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three (3) times a day until the masonry is three (3) days old.

#### **1.13 BRACING OF MASONRY DURING ERECTION**

- A. All masonry shall be adequately braced at all times during erection.

#### **1.14 COORDINATION**

- A. Openings and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry walls as required. Provide for installation of bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as required. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching.

Coordinate installation of steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

- B. Contractor performing Work of this Section shall be responsible for and coordinate with work of Section 07 11 00, Dampproofing Above Grade and all Sections of Work built-in, adjacent to, or applied to unit masonry work.

### 1.15 WARRANTY

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to, the following:
  - 1. Noticeable deterioration of unit or mortar finish.
  - 2. Chalking or dusting excessively.
  - 3. Changing color in irregular fashion.
  - 4. Cracking or spalling.
  - 5. Releasing from substrate.
  - 6. Staining or discoloring, including efflorescence.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Specifications are based on products of manufacturers named within the specifications. Other manufacturers must have a minimum of five (5) years experience manufacturing products equal to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
  - 1. Face Brick Manufacturers: Subject to compliance with requirements, provide products of one of the following:
    - a. ACME.
    - b. Cloud Ceramics.
    - c. Glen Gery Brick
    - d. General Shale Brick
    - e. Belden Brick
    - f. Interstate Brick.
    - g. Kansas Brick.
    - h. Palmetto Brick
  - 2. Concrete Masonry Units (CMU/Block) Manufacturers: Subject to compliance with requirements, provide products of one of the following:
    - a. Best Block
    - b. Upchurch Kimbrough Co. Block.
    - c. Texas Building Products, Inc.
    - d. Revels Block & Brick Co., Inc.

### 2.2 MATERIALS

- A. Concrete Masonry Units (CMU/Block):
  - 1. Type/Sizes:
    - a. Concealed cavity block and interior block, unless otherwise noted: Regular smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
      - 1) Color: Standard.

- b. Exterior exposed block: Burnished face units with 4", 8" x 16" inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
  - c. Interior exposed: Burnished face units with 4", 8" x 16" inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
  - d. Burnished CMU (BCU):
    - 1) Basis of Design: Best Block.
    - 2) Color: #704 Terrazo, Textured Finish.
    - 3) Size: 8 inch H x 16 inch L.
2. Integral Water Repellant (In exterior exposed CMU): "Dry-Block Block Admixture" integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp), or equal.
  3. Specification: Comply with ASTM C90 (Class D-2 (2 hour) and Class B-4 (4 hour)) block at rated walls).
    - a. Grade: Type N, highest standard for typical cavity block and interior use. Type S, for exterior exposed masonry walls.
    - b. Aggregate: Lightweight in accordance with ASTM C331.
  4. Curing: Rotary kiln process.
  5. Provide bullnose units at all outside corners. Except where wall tile is secured.
  6. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and fillers to match and compliment block units as shown or required.
- B. Face Brick: 4 x 2-1/4 x 8inch Modular size brick complying with the requirements of ASTM C216, Grade SW, Type FBX as selected by Architect. Colors to be selected by Architect from Manufacturer's full range.
1. BK-1:
    - a. Basis of Design: ACME.
    - b. Color: ELP 274 Mission Pink.
    - c. Finish Velour.
  2. BK-2:
    - a. Basis of Design: ACME.
    - b. Color: ELP 186 Doeskin.
    - c. Finish Velour.
- C. Face Brick: King Size face brick complying with the requirements of ASTM C216, Grade SW, Type FBX as selected by Architect. Colors to be selected by Architect from Manufacturer's full range.
- D. Mortar: Manufacturers.
1. Spectrum colors
  2. Solomon colors
  3. Spec mix colors
- a. Portland Cement: ASTM C150, Type 1.

- b. Hydrated Lime: ASTM C207, TYPE "N", typical. Use TYPE "S" for load-bearing masonry.
  - c. Aggregate: Sand conforming to ASTM C144.
  - d. Water: Clean and potable.
  - e. Admixtures For Mortar:
    - 1) General: Do not use calcium chloride
    - 2) Concrete Masonry Units: Spectrum Mortar Color or Architect approved equal.
    - 3) Face Brick: Spectrum Mortar Color or Architect approved equal.
    - 4) Integral Water Repellant (In mortar of exterior exposed CMU): "Dry- Block Mortar Admixture" integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp) or equal. Note: Water repellent block admixture and mortar admixture are not interchangeable.
2. Mix Design: (Proportions by volume) (Unless stated otherwise on Structural Drawings)
- a. Typical, Non-load bearing masonry
    - 1) Type: ASTM C270, Type "N."
    - 2) Proportions: 1 part cement, 1 part hydrated lime and 6 parts sand to provide a compressive strength of 750 psi in 28 days. Do not use calcium chloride.
  - b. Load bearing structural masonry
    - 1) Type: ASTM C270, Type "S."
    - 2) Proportions: 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide a compressive strength of 1800 psi in 28 days. Do not use calcium chloride.
- E. Grout:
- 1. Materials: (Unless stated otherwise on Structural Drawings)
    - a. Hydrated Lime: ASTM C207, TYPE "S."
    - b. Portland Cement: ASTM C150, Type 1.
    - c. Water: Clean and potable
    - d. Aggregates:
      - 1) Course aggregate shall conform to ASTM C404.
      - 2) Fine aggregate shall conform to ASTM C144.
  - 2. Mix Design: (Unless stated otherwise on Structural Drawings)
    - a. Comply with ASTM C476 to provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.
      - 1) Fine Grout: Fine grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
      - 2) Course Grout Mix: Course grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand, and 1 to 2 parts course aggregate.
- F. Reinforcement, Anchors and Tie Systems:
- 1. General: Reinforcement used in all wythes shall be galvanized after fabrication in accordance with ASTM A153, Class B-2.
  - 2. Approved Manufacturers include the following:
    - a. Heckmann Building Products
    - b. Hohmann & Barnard, Inc
    - c. Wire-Bond
  - 3. At solid multiple wythe masonry walls and single wythe masonry walls, (Interior partitions) use #9 gauge truss type reinforcing. Pre-fab corners and tees shall be used at all wall corners and intersections; width shall be two (2) inches less than nominal thickness of walls. Hohmann & Barnard "120 Truss-Mesh" at single wythe; "230 Ladder-Tri-Mesh" at multiple, or Architect approved equal.

4. At Double Wythe Cavity Walls with Insulation Board: Use Hot-dipped galvanized, #9 gauge truss type with 3/16 inch adjustable pintle wall ties. Width of truss reinforcement shall be 2 inches less than the nominal thickness of wall. 3/16 inch wall tie double eye sections welded at 16 inches o.c. extended as required for insulation thickness. Pre fab corners and tees shall be used at all wall corners and intersections. Hohmann & Barnard "270 Ladder Eye-Wire", or Architect approved equal.
  5. At Masonry Anchored to Steel Spandrel Beam and Columns: Hot-dipped galvanized, No. 315 Anchor and No. 316 Pintle Tie manufactured by Heckmann Building Products, Inc., or Architect approved equal. Anchors detailed on Structural Drawings supersede.
  6. At Veneer Brick Anchored to Light Gauge Steel Framing: Hot-dipped galvanized, No. 75HE Pos-i-Tie System utilizing self-tapping screw for steel studs with 5/8 inch barrel length, and 4 inch triangle wire tie for 2 inch cavity manufactured by Heckmann Building Products, Inc., or Architect approved equal. Anchors detailed on structural drawings supersede. Attachment screws shall be corrosion resistant type as recommended by manufacturer to suit application. Adjust wire tie size as required to conform with cavity depth if other than 2 inch.
  7. Control Joint Anchor: Equal to Heckmann Building Products, Inc. No. 351 Anchor.
  8. Corrugated Wall Tiles: Not acceptable under any circumstances.
- G. Precast Concrete U-Lintels (Contractors Option to site built masonry lintels)
1. Concrete Materials:
    - a. Portland Cement: ASTM C150 Type I or III, gray color.
    - b. Aggregates: ASTM C33.
    - c. Water: potable
    - d. Admixtures: Shall not contain calcium chloride or chloride ions
  2. Reinforcing:
    - a. Deformed Reinforcement: ASTM A615 Grade 40 or 60.
    - b. Prestressing Strand: ASTM A416 270 ksi LL.
  3. Fabrication:
    - a. Unless specified otherwise, conform to PCI MNL-116.
    - b. U-lintel units 14 feet in overall length and shorter shall be made of concrete with a minimum strength of 3500 psi at 28 days.
    - c. U-lintel units exceeding 14 feet in overall length shall be made of concrete with a minimum strength of 6000 psi at 28 days and shall be prestressed concrete.
    - d. Units shall be sand block finish except prestressed, 6 inch wide, and 12 inch wide U-lintels shall be smooth form finished.
    - e. Tolerances shall be per PCI MNL-116
    - f. Minor patching in plant is acceptable provided structural adequacy of units is not impaired
  4. Acceptable Product/Manufacturer: Cast-Crete High Strength Precast Concrete U-lintels as manufactured by Cast-Crete, Tampa, FL (800) 999-4641, and locally distributed by Headwaters, (713) 365-9077.
- H. Miscellaneous Materials: (As shown or required)
1. Reinforcing Steel: ASTM A615, Grade 60.
  2. Forms: Form grade plywood with wood studs and wales as required.
  3. Shores: Patented shores of design and manufacture sufficient to safely support imposed loads.
  4. Premolded Filler: Fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751.
  5. Flashing Cement: "Nerva-plast" cold setting mastic manufactured by Nervastral, Inc., or Architect approved equal.
  6. Building Felt: No. 15 asphalt saturated felt, ASTM D226.

7. Dovetail Anchors: 16 gauge galvanized dovetail corrugated masonry anchor, 1 inch x 3-1/2 inch manufactured by Heckman Building Products, Inc., Hohmann & Barnard, Inc., Masonry Reinforcing Corporation of America, or Architect approved equal.
8. Steel Shapes and Plates: As shown on drawings and specified in Section 05 50 00, Metal Fabrications.
9. Headed Stud Anchor: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
10. Bolts: ASTM A307. Furnish with carbon steel washers.
11. Deformed Bar Anchors: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
12. Reinforcing Bars to be Welded: ASTM A706.
13. Cavity Drainage Protection: 2 inch thick by 10 inch high by 5 feet long recycled polyester/polyethylene mesh, trapezoidal-shaped, continuous at foundation, at heads above openings, and shelf angles as indicated on drawings. Provide Mortar Net™ manufactured by Mortar Net Solutions, Burns Harbor, IN; (800) 664-6638, or Architect approved equal.
14. Masonry Color: Iron oxide pigment conforming to ASTM C979 in color(s) selected by Architect, shall be inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, and free of fillers and extenders, as manufactured by ChemSystems, Inc., Davis Colors, Solomon Grind-Chem Service, Inc., or Architect approved equal.
15. Weep Hole Vents: Injection molded vent made from flexible polyvinyl chloride in an offset "T" shape, inserted in head joints, the slotted leg of the vent allows air to pass in and out allows water to weep out and prevents water from penetrating in manufactured by Williams-Goodco, Phone: 800-521-9594 or 248-643-6400 or Email: [Wilpro@williamsproducts.net](mailto:Wilpro@williamsproducts.net). Weep hole vents shall be sized to match masonry (may require custom sizing).

### **2.3 MASONRY STRENGTH**

- A. Ultimate compressive strength of masonry as required by design and determined by prism tests shall not be less than 1,800 psi, unless stated otherwise in Structural Drawings.

### **2.4 MASONRY CLEANING MATERIALS**

- A. Detergent Cleaner: Bucket and brush hand cleaning method, BIA Technical Notes 20.
- B. Proprietary Acidic Cleaner: Cleaner designed for removing mortar/grout stains, efflorescence, and construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diedrich Technologies, Inc.
    - b. PROSOCO, Inc.
    - c. AHI Supply.
- C. The following products based on AHI Supply TexClean products are intended as a guide only and does not preclude the contractors use of equal products by listed manufacturers. Consult manufacturer prior to application for any questions or inconsistencies.



Substrate	Color/Type	Cleaning Solution
Brick	Red	Tex Clean Masonry Cleaner
	Light	Tex Tral Masonry Cleaner
	Dark	Tex Tral Masonry Cleaner
	Pavers	Tex Clean Masonry Cleaner
	Glazed	Tex Tral Masonry Cleaner
CMU	Split Face	Tex Tral Masonry Cleaner
	Burnished/Ground Face	Tex Tral Masonry Cleaner
Architectural Concrete	Natural Color/Smooth	Tex Tral Masonry Cleaner
	Textured	Tex Clean Masonry Cleaner
Stone Construction	Cast Stone	Tex Tral Masonry Cleaner
	Arriscraft	Tex Tral Masonry Cleaner
	Limestone (Unpolished)	Tex Tral Masonry Cleaner

**PART 3 - EXECUTION**

**3.1 FORMS AND SHORES**

- A. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.
- B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.

**3.2 PREPARATION OF MATERIALS**

- A. Concrete Masonry Units:
  - 1. Where cutting is required, masonry shall be cut with a sharp masonry saw.
  - 2. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.
- B. Brickwork: Dampen brick before laying in a manner consistent with the nature of the brick, the mortar, and the weather conditions.
- C. Mortar and Grout:
  - 1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable.
  - 2. Thoroughly machine mix a minimum of five (5) minutes after all materials are in mixer.
  - 3. Consistency will completely fill all spaces intended to receive grout.

4. Use within 2-1/2 hours of initial mixing.
  5. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.
- D. Reinforcement:
1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond.
  2. Cut accurately to length and bend by such methods as will prevent injury to the material.
  3. Straighten out kinks or bends.
- E. Flashing:
1. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces.
  2. Bed Joints: Coordinate work with Division 4, Masonry. Install flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back from face of masonry.
  3. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
  4. Separate copper flashing from dissimilar materials.
  5. Protect membrane flashing from overexposure to direct sunlight.

### 3.3 INSTALLATION

- A. General:
1. Do not use chipped or cracked concrete masonry units (CMU) and face brick, where exposed to view.
  2. Use masonry saws to cut and fit exposed units.
  3. Exposed masonry at exterior corners shall be solid units.
  4. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
  5. Place through-wall flashing as follows:
    - a. Place on bed of mortar and cover with mortar.
    - b. Provide at steel columns and beams in exterior masonry walls and elsewhere as indicated on the drawings or required.
    - c. Install asphalt laminated copper membrane as base flashing at all exterior cavity walls below weep holes.
    - d. Install at material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior wall sill/weep conditions, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.
  6. Lay masonry units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
  7. Do not furrow bed joints.
  8. Stop off horizontal run by racking back in each course; toothing is not permitted.
  9. Adjust units to final position while mortar is soft and plastic.
  10. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh mortar.
  11. When joining fresh masonry to set or partially set masonry:
    - a. Remove loose masonry units and mortar
    - b. Clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.
- B. Metal Door Frames: Fill jamb frames solid with mortar. Build in anchors.

- C. Lintels and Bond Beams: Provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.
- D. Corners: Connect corners with No. 9 galvanized wire tie using one tie for each 4 inches of nominal wall thickness.
- E. Partition Tops: Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Sealant section. Anchor top of walls to deck or structure.
- F. Mortar Beds:
  - 1. Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
  - 2. Lay units with full mortar coverage on horizontal and vertical joints in all courses.
  - 3. Provide sufficient mortar on ends of masonry unit to fill head joints.
  - 4. Rock closures into place with head joints thrown against two adjacent masonry units in place.
  - 5. Do not pound corners or jambs to fit stretcher units after setting in place.
  - 6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.
- G. Mortar Joints and Patterns:
  - 1. Lay CMU in running one-half (1/2) bond pattern, unless noted otherwise.
  - 2. Lay brick in running one-third (1/3) bond pattern, unless noted otherwise on drawings. Refer to drawings for accent coursing.
  - 3. Provide flush joints where concealed from view and where dampproofing is scheduled.
  - 4. Provide standard concave tooled joint where masonry is exposed to view for brick and CMU, typically.
  - 5. All mortar joints to be of consistent size.
  - 6. Provide soldier courses where indicated, refer to the elevations.
  - 7. All horizontal joints shall be concave tooled joint at face of units, unless noted otherwise.
  - 8. Provide raked joints at all exposed burnished cmu locations.
- H. Reinforcement, Anchor and Tie Systems:
  - 1. General:
    - a. Completely embedded in mortar or grout.
    - b. All reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have no less than 5/8 inch mortar coverage from the exposed face.
    - c. Where modular brick is used with brick coursing at 16 inches on center, provide ladder reinforcing within each wythe at 16 inches o.c. vertically for exterior wythe and back-up wythe, whether detailed or not. For other than modular brick, refer to Paragraph h. below.
    - d. Veneer anchors at exterior sheathed covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws. Spacing shall be same as stud spacing o.c. horizontally and 16 inches o.c. vertically.
    - e. Veneer anchors at Interior brick walls with metal stud back-up shall be the same as Paragraph "d" above, except anchors shall be attached directly to metal stud with recommended corrosion resistant fasteners in accordance with manufacturer's recommendations.
    - f. At intersection of all perpendicular masonry walls provide two (2) vertical rows of ladder type reinforcing at 16 inches o.c. vertically.
    - g. Weld veneer anchors to structural steel in accordance with manufacturer's recommendations. Touch-up steel shop paint and galvanized coating on anchor

- with touch-up primer and finish coats to match damaged coating in accordance with manufacturer's recommendations.
- h. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.
  - i. Splices in reinforcement: Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall be eight (8) inches. Welded or mechanical connection shall develop the strength of the reinforcement.
  - j. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions are acceptable.
  - k. Place joint reinforcement in the first two (2) bed joints above and the first two (2) bed joints below masonry openings. Extend extra reinforcing two (2) feet beyond jambs.
  - l. Provide masonry ties at floor and roof decks as indicated.
- I. Flashing:
- 1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
  - 2. Application Guidelines - Install flashing at the following locations:
    - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
    - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill/weep conditions, exterior door and window head/weep conditions, masonry wall cap flashing and masonry wall base flashing.
  - 3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
  - 4. Provide drip edge flashing at weep conditions with membrane flashing. Cut membrane flush with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
  - 5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
  - 6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
  - 7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
  - 8. Thru-Wall Flashing: Shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
  - 9. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and

- upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
10. Heads and Sills: Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weepholes.
  11. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
  12. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
  13. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
  14. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
  15. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
  16. Reglet Termination: Insert wedge into place and seal carefully with adhesive
  17. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
  18. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.
- J. Laying Masonry: Lay units plumb, level, and true to line with full head and bed joints. Butter ends of masonry with sufficient mortar to fill head joints. Do not furrow bed joints. Slope top of bed joint toward center of wall to minimize amount of mortar forced into grout space. Remove mortar, protruding from joints into grout space, before pouring grout.
- K. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding eight 8 feet-0 inches with a minimum clearance of 1/4 inch from masonry and not less than one (1) bar diameter between bars.
  2. When a foundation dowel is not in alignment with a vertical block cell or pilaster, slope it not more than one (1) horizontal in six (6) vertical to bring it into proper alignment before grouting.
  3. Place horizontal reinforcing bars in continuous masonry courses, consisting of bond-beam or trough block units, and solidly grout in place.
  4. Use straight reinforcing bars except for bends around corners and where bends or hooks are detailed on plans.
  5. Lap reinforcing steel 40 bar diameters minimum where spliced and wire together.
- L. Grouting: Where detailed place grout in reinforced masonry beams, walls, columns, and pilasters. All cells and spaces containing reinforcing bars shall be filled with grout. Wherever possible grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.
1. Prior to grouting clean space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material. Grout shall be placed so all spaces designated to be grouted shall be filled with grout and grout shall be confined to those specific spaces.

2. Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation of constituents and shall be mixed thoroughly.
3. Between grout pours a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with grout stopping a minimum of 1-1/2 inches below a mortar joint, except at top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below top of masonry.
4. Reinforcement shall be placed prior to grouting. Bolts shall be accurately set with templates or by approved equivalent means and held in place to prevent movement.
5. Segregation of grout materials and damage to masonry shall be avoided during the grouting process. Adequately brace masonry to prevent displacement or cracking during grouting operations.
6. Grout shall be consolidated by mechanical vibrator during placing, before loss of plasticity, in a manner to fill grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated, or puddled.
7. Grout shall not be handled nor pumped utilizing aluminum equipment.
8. Size and height limitations of grout space or cell shall be as follows:

GROUT TYPE	GROUT POUR MAX. HEIGHT (FEET)	LEAST CLEAR DIMENSIONS		CLEANOUTS REQUIRED
		Width of Grout Space (In.)	CMU Cell Dim. Dims. (In. x In.)	
Fine	1	3/4	1-1/2 x 2	No
Fine	5	1-1/2	1-1/2 x 2	No
Fine	8	1-1/2	1-1/2 x 3	Yes
Coarse	1	1-1/2	1-1/2 x 3	No
Coarse	5	2	2-1/2 x 3	No
Coarse	8	2	3 x 3	Yes

- a. Clear dimension is the cell or grout space width less mortar projections.
- b. Grout space width shall be increased by the horizontal projection of the diameters of horizontal bars within the cross section of the grout space.

9. Place grout in lifts not exceeding 8 feet-0 inches.
- M. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report discrepancies or procedures which may adversely affect performance of masonry work.
- N. Brick Weep holes:
1. Provide weep holes above all thru-wall flashings where weep holes occur at the base of the wall. The mason shall coordinate the location of the thru-wall flashings with the location of the sidewalks on the civil engineering drawings. All weep holes shall be at least one course below finished floor or at the first course of brick above the sidewalks. Pay particular attention to areas near exterior doors.
  2. Ensure cavity drainage protection is properly installed.
  3. Leave head joint free and clean of mortar.
  4. Spacing: 20 inches on center maximum for king sized brick, and 24 inches on center for modular brick and block, unless shown otherwise.
  5. Keep weep holes and area above flashing free of mortar droppings.
  6. Coordinate weep holes to be located above sidewalks and paving.
  7. Insert bug screens in all weepholes.

- O. Sealant Joints:
1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings.
  2. Uniform depth: 3/4 inch.
  3. Uniform width: As shown on the drawings but not less than 1/4 inch.
  4. Provide sample for Architect's approval.
  5. Refers to drawing for locations and details of accent joints.
- P. Movement Joints (Expansion Joints and Control Joints):
1. Locate expansion and control joints as shown on drawings, or if not shown, comply with the following:
    - a. General:
      - 1) Vertical expansion joints shall be placed in the brick wythe and control joints shall be placed in the concrete masonry wythe, although they do not necessarily have to be aligned.
      - 2) Mortar and joint reinforcement shall not bridge brick movement joints.
      - 3) Mortar joints which stop at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.
    - b. Vertical Expansion Joints:
      - 1) Locate expansion joints on long straight walls without openings maximum 25 feet-0 inches.
      - 2) Locate expansion joints at the corner of walls perpendicular to one another. In instances, where the joint is not desired at the corner, the expansion joint shall be located within 10 feet-0 inches of the corner in either wall, but not necessarily both. The spacing of expansion joints around a corner shall not exceed the spacing of expansion joints in a straight wall. For example, if the spacing between expansion joints on a straight wall is 25 feet-0 inches, then the spacing of expansion joints around a corner could be 10 feet-0 inches on one side of the corner and 15 feet-0 inches on the other side. Joint reinforcement may be added around wall corners to provide added tensile strength to the corner, but joint reinforcement shall not bridge the expansion joint.
    - c. Offsets and Setbacks:
      - 1) Locate expansion joints at 10 feet-0 inches maximum on one side of the offset or setback. The spacing of expansion joints around an offset or setback shall not exceed the spacing of expansion joints in a straight wall. See expansion joints at corners of perpendicular walls to one another above for example of spacing.
    - d. Openings (Doors and Windows):
      - 1) Locate vertical expansion joints along the edge or jamb of the opening of windows and doors. Single opening windows and doors under 6 feet-0 inches in width shall have expansion joint on one (1) side of the edge or jamb of the opening as determined by the Architect, unless shown otherwise on drawings. Windows and doors 6 feet-0 inches and over in width shall have expansion joints on both sides of the edge or jamb of the opening.
      - 2) Where masonry above an opening is supported by shelf angles attached to the structure, a vertical expansion joint shall be located alongside the opening, continuing through the horizontal support.
      - 3) Where masonry above the opening is supported by loose lintels (unattached to the structure), special detailing and construction is required. If the expansion joint runs along side the opening, the loose

steel lintel shall be allowed to expand independently of the masonry. To accomplish this, form a slip plane with flashing located above and below the angle. A backer rod and sealant shall be installed in front of the toe of the angle, and space shall be left at the end of the angle. Thus, a pocket will be formed which will allow movement of the steel angle within the brickwork. If the joint cannot be built in this manner, then the vertical expansion joint shall not be located alongside the opening, but rather, with Architect's prior approval, the joint shall be located halfway between the openings.

- e. Intersections and Junctions:
  - 1) Locate expansion joints at intersections of masonry walls and walls which serve different functions. If the masonry is not required to be bonded at the intersection, an expansion joint shall be incorporated. Walls which intersect at other than right angles are also vulnerable to cracking at the intersection.
  - 2) Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.
- f. Parapets:
  - 1) All vertical expansion joints shall be carried through the parapets.
  - 2) Additional expansion joints shall be halfway between those running full height, unless the parapet is reinforced. These additional expansion joints shall continue down to a horizontal expansion joint, or continue to the base of the wall.
- g. Horizontal Expansion Joints:
  - 1) Locate horizontal expansion joints at shelf angles supporting brick masonry.
- h. Control Joints:
  - 1) Locate CMU control joints directly over concrete slab control joints.
  - 2) Whenever possible, lay out CMU so that control joint will coincide with CMU module (25 feet-0 inch maximum spacing between control joints), unless noted otherwise on drawings.
  - 3) Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns.
  - 4) Install backer rod and sealant in accordance with manufacturer's instructions.

### 3.4 ALLOWABLE TOLERANCES

- A. Maximum Variation from Plumb:
  - 1. In lines and surfaces of columns, walls and at rises:
    - a. 1/4 inch in 10 feet (1:480).
    - b. 3/8 inch in 20 feet (maximum).
    - c. 1/2 inch in 40 feet (1:960).
  - 2. For external corners, expansion joints and other conspicuous lines:
    - a. 1/4 inch in 20 feet (maximum).
    - b. 1/2 inch in 40 feet (1:960).
- B. Maximum variation from level:
  - 1. 1/4 inch in any bay or 20 feet.
  - 2. 1/2 inch in 40 feet (1:960).



### **3.5 REMOVAL OF FORMS AND SHORES**

- A. Do not remove shores and forms under reinforced masonry beams, lintels, and soffits until members have hardened sufficiently to carry their own weight and other super imposed loads. Providing that sufficient curing has taken place, leave forms and shores in place as follows:
  - 1. Beam and lintels: Minimum ten (10) days.
- B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads on them. Allow an additional 48 hours before applying concentrated loads such as trusses, girders, and beams.

### **3.6 REPAIRING, POINTING AND CLEANING**

- A. All holes in exposed masonry shall be pointed, and defective joints shall be cut out and re-pointed with mortar.
- B. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet, in a location approved by Architect. No further cleaning work may proceed until the sample area has been approved by Architect, after which, the same cleaning materials and method shall be used on remaining wall area. Sash, metal lintels and other corrodible parts shall be thoroughly protected.  
Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.
  - 1. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
  - 2. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
  - 3. Mix materials in strict accordance with manufacturers instructions; do not dilute unless permitted by manufacturer.
  - 4. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
  - 5. No high pressure washers are permitted.
  - 6. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
  - 7. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

### **3.7 REPAIR OR REPLACEMENT OF DAMAGED WORK**

- A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at Contractor's expense and in conformity with all requirements of drawings and specifications. Removal and replacement of masonry work shall be performed in such a manner as not to impair the appearance or strength of the structure in any way.

### **3.8 CLEAN-UP AND PROTECTION**

- A. Clean up all debris caused by work of this Section, keeping the area clean and neat at all times.
- B. Cover all unfinished work at night against the elements with plastic sheeting, building paper, heavy canvas or other material approved by Architect to prevent water from entering cavities.
- C. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

**3.9 FIELD QUALITY CONTROL AND TESTING**

- A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

**END OF SECTION 04 20 00**

## **SECTION 04 22 00 - CONCRETE UNIT MASONRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  1. Concrete masonry units.
  2. Mortar and grout.
  3. Steel reinforcing bars.
  4. Masonry joint reinforcement.
  5. Ties and anchors.
  6. Embedded flashing.
  7. Miscellaneous masonry accessories.

#### **1.3 DEFINITIONS**

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
  1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

#### **1.5 PRECONSTRUCTION TESTING**

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
  1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
  2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
  - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
  - 1. Decorative CMUs, in the form of small-scale units.
  - 2. Pre-faced CMUs.
  - 3. Colored mortar.
  - 4. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
  - 1. CMUs.
  - 2. Accessories embedded in masonry.

## 1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
  - 1. Masonry units.
    - a. Include material test reports substantiating compliance with requirements.
    - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Grout mixes. Include description of type and proportions of ingredients.
  - 5. Reinforcing bars.
  - 6. Joint reinforcement.
  - 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## **1.8 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
1. Build sample panels for each type of unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
  2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
  3. Protect approved sample panels from the elements with weather-resistant membrane.
  4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
    - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

### **1.10 PROJECT CONDITIONS**

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## **PART 2 - PRODUCTS**

### **2.1 MASONRY UNITS, GENERAL**

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

### **2.2 CONCRETE MASONRY UNITS**

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
  - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
- C. CMUs: ASTM C 90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
  - 2. Density Classification: Normal weight unless otherwise indicated.
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
  - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

### **2.3 CONCRETE AND MASONRY LINTELS**

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## **2.4 MORTAR AND GROUT MATERIALS**

- A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
- F. Mortar Cement: ASTM C 1329.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- H. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints, less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
  - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
- J. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
- L. Water: Potable.

## **2.5 REINFORCEMENT**

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.



1. Interior Walls: Mill- galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter or as indicated on Drawings.
4. Wire Size for Cross Rods: 0.148-inch diameter or as indicated on Drawings.
5. Wire Size for Veneer Ties: 0.148-inch diameter or as indicated on Drawings.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units].

- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

## 2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
  2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, with ASTM A 153, Class B coating.
  3. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
  2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
  2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel.
  3. Corrugated Metal Ties: Metal strips not less than 7/8-inch-wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.075-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.
- D. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4-inch-thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153] [Epoxy coating 0.020 inch thick.

## **2.7 MISCELLANEOUS ANCHORS**

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.
- B. Post-installed Anchors: Torque-controlled expansion anchors or chemical/adhesive anchors unless otherwise indicated on Drawings.
  - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.

## **2.8 EMBEDDED FLASHING MATERIALS**

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as indicated on Drawings. Include accessories, adhesives, primers, and seam tapes as applicable.

## **2.9 MISCELLANEOUS MASONRY ACCESSORIES**

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
    - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

## **2.10 MORTAR AND GROUT MIXES**

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. For reinforced masonry, use Portland cement-lime mortar.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
  2. For reinforced masonry, use Type S.
  3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
  4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C 476, Table 1 or] paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi except where indicated on Drawings.
  3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

### **3.3 TOLERANCES**

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch or minus 1/4-inch.
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch.
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
  - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
  - 5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10 feet, 3/8-inch in 20 feet, or 1/2-inch maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
- C. Joints:
  - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch.
  - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
  - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus 1/4-inch.
  - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch.

### **3.4 LAYING MASONRY WALLS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, unless otherwise indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches or less on center unless otherwise indicated.
  - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
  - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

### **3.5 MORTAR BEDDING AND JOINTING**

- A. Lay hollow CMUs as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
  - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  - 2. Allow cleaned surfaces to dry before setting.
  - 3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### **3.6 MASONRY JOINT REINFORCEMENT**

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### **3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE**

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
  - 1. Provide an open space not less than inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### **3.8 CONTROL AND EXPANSION JOINTS**

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

### **3.9 LINTELS**

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

### **3.10 FLASHING**

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
  - 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
  - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
  7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

### **3.11 REINFORCED UNIT MASONRY INSTALLATION**

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches.

### **3.12 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.



- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

### **3.13 REPAIRING, POINTING, AND CLEANING**

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

### **3.14 MASONRY WASTE DISPOSAL**

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in each dimension.
  - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
  - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION 04 22 00**

## **SECTION 05 12 00 - STRUCTURAL STEEL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Structural steel.
  - 2. Prefabricated building columns.
- B. Related Sections:
  - 1. Section 01 45 23 "Testing and Inspection Services".
  - 2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
  - 3. Section 05 31 00 "Steel Decking".
  - 4. Section 13 34 19 "Metal Building Systems".

#### **1.3 DEFINITIONS**

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
  - 1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
  - 2. Welded built-up members with plates thicker than 2 inches.
  - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

#### **1.4 REFERENCES**

- A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
  - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
  - 2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.
  - 3. AISC "Specification for Architecturally Exposed Structural Steel".
  - 4. AISC's "Seismic Provisions for Structural Steel Buildings".
  - 5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".

6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: System as indicated on Drawings.

#### **1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  2. Include embedment drawings.
  3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
  5. Identify members and connections of the seismic-load-resisting system.
  6. Indicate locations and dimensions of protected zones.
  7. Identify demand critical welds.
  8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
  2. Electrode manufacturer and trade name, for demand critical welds.

#### **1.7 INFORMATIONAL SUBMITTALS**

- A. Submit the following informational submittals:
1. Qualification Data: For qualified installer, fabricator, and testing agency.
  2. Welding certificates.
  3. Mill test reports for structural steel, including chemical and physical properties.

4. Product Test Reports: For the following:
  - a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - b. Direct-tension indicators.
  - c. Tension-control, high-strength bolt-nut-washer assemblies.
  - d. Shear stud connectors.
  - e. Shop primers.
5. Source quality-control reports.

## **1.8 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
  1. AISC 303.
  2. AISC 341 and AISC 341s1.
  3. AISC 360.
  4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
  3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

## **1.10 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

## **PART 2 - PRODUCTS**

### **2.1 STRUCTURAL-STEEL MATERIALS**

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
  - 1. W-Shapes: 60 percent.
  - 2. Channels, Angles, M, S-Shapes: 60 percent.
  - 3. Plate and Bar: 25 percent.
  - 4. Cold-Formed Hollow Structural Sections: 25 percent.
  - 5. Steel Pipe: 25 percent.
  - 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: Refer Structural General Notes.
- C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.
- D. Plate and Bar: Refer Structural General Notes.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.
- F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.
- G. Steel Pipe: Refer Structural General Notes.
  - 1. Weight Class: See Plans.
  - 2. Finish: Black except where indicated to be galvanized.
- H. Welding Electrodes: Comply with AWS requirements.

### **2.2 BOLTS, CONNECTORS, AND ANCHORS**

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
  - 1. Finish: Hot-dip or mechanically deposited zinc coating.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain or Mechanically deposited zinc coating, where required.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
  1. Configuration: Straight.
  2. Nuts: ASTM A 563 heavy-hex carbon steel.
  3. Plate Washers: ASTM A 36 carbon steel.
  4. Washers: ASTM F 436, Type 1, hardened carbon steel.
  5. Finish:
    - a. General Condition – Plain
    - b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Amscot Structural Products Corp.
    - b. Fluorocarbon Company Limited.
    - c. R.J. Watson Bridge & Structural Engineered Systems.
    - d. Seismic Energy Products, L.P.
  2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
  3. Coefficient of Friction: Not more than 0.05.
  4. Design Load: Not less than 5,000 psi .
  5. Total Movement Capability: 2 inches.

### **2.3 PRIMER**

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.
- D. Galvanizing Repair Paint: SSPC-Paint 20.

### **2.4 GROUT**

- A. Refer Section 03 30 00.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Camber structural-steel members where indicated.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
  2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
  3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
  4. Camber tolerance
    - a. Beams 50 feet and less; plus or minus 1/2 inch.
    - b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
    - c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
  5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
  6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.



1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
  2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.
- I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
  2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
  3. Bolts over 1 3/4 inch diameter: 1 inch oversize.
- J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
  2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
  3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
  4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick
  5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
  6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
  7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick
- K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
  2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  2. Surfaces to be field welded.
  3. Surfaces to be high-strength bolted with slip-critical connections.
  4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
  5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.
- F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- G. GALVANIZING
- H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
  - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

## **2.8 SOURCE QUALITY CONTROL**

- A. Testing Agency: Refer Section 01 45 23.
  - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

### **3.3 ERECTION**

- A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of baseplate.
  3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

### **3.4 FIELD CONNECTIONS**

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
  1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: See Section 01 45 23.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### **3.6 REPAIRS AND PROTECTION**

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

**END OF SECTION 05 12 00**

## **SECTION 05 12 13 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes architecturally exposed structural-steel framing.
  - 1. Requirements in Section 05 12 00 "Structural Steel Framing".
- B. Related Sections:
  - 1. Section 01 45 23 "Testing and Inspection Services".
  - 2. Section 05 12 00 "Structural Steel Framing".

#### **1.3 DEFINITIONS**

- A. Architecturally Exposed Structural Steel: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within 96 inches (2400 mm) vertically and 36 inches (900 mm) horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within 20 feet (6 m) vertically and horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

#### **1.4 ACTION SUBMITTALS**

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Include embedment drawings.
  - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
  - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
  - 5. Indicate exposed surfaces and edges and surface preparation being used.
  - 6. Indicate special tolerances and erection requirements.
- B. Samples: Submit samples of AESS to set quality standards for exposed welds for Category 1 AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld ground smooth and blended.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer and fabricator.

### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Preinstallation Conference: Conduct conference at Project site.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

### **1.8 PROJECT CONDITIONS**

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

### **1.9 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

## **PART 2 - PRODUCTS**

### **2.1 BOLTS, CONNECTORS, AND ANCHORS**

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
  1. Finish: Plain.

- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

## 2.2 PRIMER

- A. Primer: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: SSPC-Paint 20.

## 2.3 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
  - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
  - 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
  - 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
  - 4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
  - 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
  - 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
  - 7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
  - 8. Fabricate Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
  - 9. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates for steel that is designated AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
  - 1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet (6 m) under any lighting conditions.
  - 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch (13 mm).
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch (0.8 mm) for Category 1 AESS.
- E. Bolt Holes: Cut, drill, mechanically (CNC) thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
  - 1. Cut, drill, mechanically (CNC) thermal cut, or punch holes perpendicular to steel surfaces.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## **2.4 SHOP CONNECTIONS**

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
  - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
  - 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
  - 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 and 2 AESS is exposed to weather.
  - 4. Provide continuous welds of uniform size and profile where Category 1 and 2 AESS is welded.
  - 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus 0 inch (plus 1.5 mm, minus 0 mm) for Category 1 and Category 2 AESS.
  - 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
  - 7. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
  - 8. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.

## **2.5 GALVANIZING**

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
  - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  - 2. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
  - 3. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

## **2.6 SHOP PRIMING**

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Surfaces to be high-strength bolted with slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials.
  - 5. Galvanized surfaces.



- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
  - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

#### **3.3 ERECTION**

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
  - 1. Erect Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
  - 2. Erect Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection.

#### **3.4 FIELD CONNECTIONS**

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.

- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
  - 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
  - 2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
  - 3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

### **3.6 REPAIRS AND PROTECTION**

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.

**END OF SECTION 05 12 13**

## **SECTION 05 21 00 – STEEL OPEN WEB JOIST FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. K-series steel joists.
  - 2. KCS-type K-series steel joists.
  - 3. K-series steel joist substitutes.
  - 4. LH- and DLH-series long-span steel joists.
  - 5. CJ-series composite steel joists.
  - 6. Joist girders.
  - 7. Joist accessories.
  - 8. Extended ends.
  - 9. Ceiling extensions.
  - 10. Bearing plates.
  - 11. Bridging.
  - 12. Side wall anchors.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-in-Place Concrete".
  - 2. Section 01 45 23 "Testing and Inspection Services"
  - 3. Section 04 20 00 "Unit Masonry".
  - 4. Section 05 12 00 "Structural Steel Framing".
  - 5. Section 05 31 13 "Steel Floor Decking".
  - 6. Section 05 31 23 "Steel Roof Decking".

#### **1.3 REFERENCES**

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
- B. AWS D1.1 Structural Welding Code
- C. SJI "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders".
- D. SDI "Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution".
- E. SSPC Steel Structures Painting Council Painting Manual.
- F. UL Fire Resistance Directory.
- G. ICBO Product Evaluation Reports.
- H. FM Roof Assembly Classifications.

- I. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

#### **1.4 DEFINITIONS**

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of joist, accessory, and product.  
Review LEED requirements with Project Architect and edit as needed. References to LEED credits below MAY NOT be current.
- B. Shop Drawings:
  1. Include layout, designation, number, type, location, and spacing of joists.
  2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
  3. Indicate locations and details of bearing plates to be embedded in other construction.
  4. Shop drawings containing special joists shall be submitted with a design load summary for each special joist design. Load summary will be reviewed and returned with the joist submittal. Shop drawings containing special joists submitted without the specified load summary will be returned unchecked as an incomplete submittal. Shop drawings containing special joists shall be signed and sealed by the qualified professional engineer responsible for the design of the joists.

#### **1.6 INFORMATIONAL SUBMITTALS**

- A. Submit the following informational submittals:
  1. Qualification Data: For manufacturer.
  2. Welding certificates.
  3. Manufacturer certificates.
  4. Mill Certificates: For each type of bolt.
  5. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
- B. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

## 1.9 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and or masonry construction.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Use ASD; data are given at service-load level.
- C. Design special joists to withstand design loads with live-load deflections no greater than the following:
  - 1. Floor Joists: Vertical deflection of 1/360 of the span.
  - 2. Roof Joists: Vertical deflection of 1/360 of the span.
- D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

### 2.2 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.

### 2.3 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
  - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions and Extended Ends: Provide top chord extension or extended ends where shown on plans. Design for load indicated on plans.
- E. Camber joists according to SJI's Specifications unless noted otherwise.
- F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

### 2.4 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on plan.
  - 1. Joist Type: Refer to Drawings.

2. End Arrangement: Refer to Drawings.
3. Top-Chord Arrangement: Refer to Drawings.

- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Camber long-span steel joists according to SJI's Specifications unless noted otherwise.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

## **2.5 JOIST GIRDERS**

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on plan.
  1. End Arrangement: Refer to Drawings.
  2. Top-Chord Arrangement: Refer to Drawings.
- B. Provide holes in chord members for connecting and securing other construction to joist girders.
- C. Camber joist girders according to SJI's Specifications unless noted otherwise.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

## **2.6 PRIMERS**

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

## **2.7 JOIST ACCESSORIES**

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint for interior exposure or Hot-dip zinc coat according to ASTM A 123/A 123M for exterior or weather exposure.
- C. Furnish ceiling extensions (where indicated), either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- D. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.  
Finish: Plain, uncoated.

- E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish: Plain.
- F. Welding Electrodes: Comply with AWS standards.
- G. Galvanizing Repair Paint: ASTM A 780.
- H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## **2.8 CLEANING AND SHOP PAINTING**

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 2 mil thick.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.
- C. Before installation, splice joists delivered to Project site in more than one piece. Space, adjust, and align joists accurately in location before permanently fastening.
- D. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- E. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- F. Field weld joists to supporting steel bearing plates and framework as indicated on Drawings. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.

- G. Bolt joists to supporting steel framework using high-strength structural bolts as indicated on Drawings. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: See Section 01 45 23.

### **3.4 REPAIR AND PROTECTION**

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
- C. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
  - 1. Apply a compatible primer of same type as primer used on adjacent surfaces.
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

**END OF SECTION 05 21 00**



## **SECTION 05 31 13 - STEEL FLOOR DECKING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  1. Composite floor deck.
  2. Electrified cellular floor deck.
  3. Noncomposite form deck.
  4. Noncomposite vented form deck.
- B. Related Requirements:
  1. Section 01 45 23 "Testing and Inspection Services".
  2. Section 03 30 00 "Cast-in-Place Concrete".
  3. Section 05 12 00 "Structural Steel Framing".
  4. Section 05 21 00 "Steel Joist Framing"

#### **1.3 REFERENCES**

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
  1. AWS D1.1 - Structural Welding Code
  2. AWS D1.3 – Structural Welding Code – Sheet Steel
  3. SDI – Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution.
  4. SSPC – Painting Manual
  5. UL – Fire Resistance Directory
  6. ICBO – Product Evaluation Reports

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
  1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Submit the following informational submittals:
  1. Welding certificates.
  2. Product Certificates: For each type of steel deck.
  3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
    4. Power-actuated mechanical fasteners.
    5. Evaluation Reports: For steel deck.
    6. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### **2.2 COMPOSITE FLOOR DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
  - 2. Canam United States; Canam Group Inc.
  - 3. CMC Joist & Deck.
  - 4. Consolidated Systems, Inc.; Metal Dek Group.
  - 5. Cordeck.
  - 6. DACS, Inc.
  - 7. Epic Metals Corporation.
  - 8. Marlyn Steel Decks, Inc.
  - 9. New Millennium Building Systems, LLC.
  - 10. Nucor Corp.; Vulcraft Group.
  - 11. Roof Deck, Inc.
  - 12. Verco Manufacturing Co.
  - 13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
  - 14. CSM Metal Deck

- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
  - 1. Galvanized-Steel Sheet: As indicated in Structural General Notes.
  - 2. Profile Depth: As indicated on plan.
  - 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
  - 4. Span Condition: Triple span or more.

### **2.3 ELECTRIFIED CELLULAR FLOOR DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. CMC Joist & Deck.
  - 2. Consolidated Systems, Inc.; Metal Dek Group.
  - 3. Cordeck.
  - 4. HH Robertson Floor Systems; a CENTRIA company.
  - 5. Marlyn Steel Decks, Inc.
  - 6. New Millennium Building Systems, LLC.
  - 7. Nucor Corp.; Vulcraft Group.
  - 8. Verco Manufacturing Co.
  - 9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- C. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from single manufacturer.
- D. Electrified Cellular Floor Deck: Fabricate steel-sheet cellular floor-deck panels, consisting of a ribbed top section welded to a lower flat-bottom sheet with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck" in SDI Publication No. 31. Fabricate deck to the minimum section properties, width of panel, number and area of cells per panel indicated, and the following:
  - 1. Cellular Deck Type: Composite.
  - 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.
  - 3. Profile Depth: As indicated on plan.
  - 4. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
  - 5. Span Condition: Triple span or more.
  - 6. Factory punch holes, of size and arrangement indicated, into each deck cell at preset inserts and header duct locations.

### **2.4 NONCOMPOSITE FORM DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
  - 2. Canam United States; Canam Group Inc.
  - 3. CMC Joist & Deck.
  - 4. Consolidated Systems, Inc.; Metal Dek Group.
  - 5. Cordeck.
  - 6. DACS, Inc.

7. Marlyn Steel Decks, Inc.
  8. New Millennium Building Systems, LLC.
  9. Nucor Corp.; Vulcraft Group.
  10. Roof Deck, Inc.
  11. Valley Joist; Subsidiary of EBSCO Industries, Inc.
  12. Verco Manufacturing Co.
  13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 80 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard Gray.
  2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G90 zinc coating.
  3. Profile Depth: As indicated on Plan.
  4. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
  5. Span Condition: Triple span or more.
  6. Side Laps: Overlapped or interlocking seam at Contractor's option.

## 2.5 NONCOMPOSITE VENTED FORM DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
  2. Canam United States; Canam Group Inc.
  3. CMC Joist & Deck.
  4. Consolidated Systems, Inc.; Metal Dek Group.
  5. Marlyn Steel Decks, Inc.
  6. New Millennium Building Systems, LLC.
  7. Nucor Corp.; Vulcraft Group.
  8. Roof Deck, Inc.
  9. Verco Manufacturing Co.
  10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G60 zinc coating.
  2. Profile Depth: As indicated on Plan.
  3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
  4. Span Condition: Triple span or more.
  5. Side Laps: Overlapped or interlocking seam at Contractor's option.
  6. Vent Slot Area: Manufacturer's standard vent slots providing 1.5 percent open area.

## 2.6 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated on Drawings.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
  - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

### **3.3 FLOOR-DECK INSTALLATION**

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 3/4 inch, nominal.
  - 2. Weld Spacing: Space and locate welds as indicated on Drawings.
  - 3. Weld Washers: Install weld washers at each weld location where deck is 22 gage or less.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch only with concrete filled decks.
  - 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Revise "Floor-Deck Closures" Paragraph below to suit Project. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from units indicated.
  - 1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.
- G. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

### **3.4 COMPOSITE FLOOR DECK INSTALLATION**

- A. The composite steel deck shall be connected to the supporting steel beams by welding the shear/headed stud connectors through the deck as indicated in the drawings. Contractor to verify the attachment of the deck to the supporting member after the headed stud is welded. Improper amperage may cause burn through around the stud and the deck may not be adequately attached to the supporting deck.
- B. Where shear/headed stud connectors are not specified, the metal deck shall be attached to the supporting steel with 3/4-inch diameter puddle welds at a maximum spacing of 12 inches.
- C. Where the specified shear/headed stud connector spacing exceeds 12 inches, provide 3/4-inch diameter puddle welds between shear/headed stud connectors to maintain a maximum deck connection of 12 inches.
- D. Where deck units abut side to side or end to end over a supporting member provide 3/4-inch diameter puddle welds on each deck unit at a maximum spacing of 12 inches.
- E. Shear/Headed Stud Connectors: Field weld shear/headed stud connectors through deck to supporting frame according to AWS D1.1 and manufacturer's written instructions. Located connectors as indicated in the drawings. Remove and discard arc shields after welding shear/headed stud connectors.

### **3.5 DECK AND FLOOR DEFLECTION**

- A. The metal deck is designed to deflect up to 3/4-inch.
- B. Uncambered steel beams are designed to be within code required deflection limits (Span/240). Cambered steel beams are designed to have a final deflected shape of less than 1/2-inch. Due to field tolerances and camber tolerances, these design limits may be slightly exceeded.
- C. The contractor shall account for any additional concrete required due to these deflected shape tolerances.

### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency: Refer Section 01 45 23.
- B. Remove and replace work that does not comply with specified requirements.
- C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

### **3.7 PROTECTION**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 05 31 00**



## **SECTION 05 31 23 - STEEL ROOF DECKING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Roof deck.
  - 2. Acoustical roof deck.
  - 3. Noncomposite vented roof deck.
- B. Related Requirements:
  - 1. Section 01 45 23 "Testing and Inspection Services"
  - 2. Section 05 12 00 "Structural Steel Framing".

#### **1.3 REFERENCES**

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
  - 1. AWS D1.1 – Structural Welding Code
  - 2. AWS D1.3 – Structural Welding Code – Sheet Steel
  - 3. SDI – Design Manual
  - 4. SSPC – Painting Manual
  - 5. UL – Fire Resistance Directory
  - 6. ICBO – Product Evaluation Reports
  - 7. FM – Roof Assembly Classifications
- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
  - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - 1. Power-actuated mechanical fasteners.
  - 2. Acoustical roof deck.

- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
  - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### **2.2 ROOF DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
  - 2. Canam United States; Canam Group Inc.
  - 3. CMC Joist & Deck.
  - 4. Consolidated Systems, Inc.; Metal Dek Group.
  - 5. Cordeck.
  - 6. DACS, Inc.
  - 7. Epic Metals Corporation.

8. Marlyn Steel Decks, Inc.
  9. New Millennium Building Systems, LLC.
  10. Nucor Corp.; Vulcraft Group.
  11. Roof Deck, Inc.
  12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
  13. Verco Manufacturing Co.
  14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
  15. CSM Metal Deck
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard.
  2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
  3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard.
  4. Deck Profile: As indicated on plan.
  5. Profile Depth: As indicated on plan.
  6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
  7. Span Condition: Triple span or more.
  8. Side Laps: Overlapped or interlocking seam at Contractor's option.

### **2.3 ACOUSTICAL ROOF DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
  2. Canam United States; Canam Group Inc.
  3. CMC Joist & Deck.
  4. Consolidated Systems, Inc.; Metal Dek Group.
  5. Cordeck.
  6. DACS, Inc.
  7. Epic Metals Corporation.
  8. Marlyn Steel Decks, Inc.
  9. New Millennium Building Systems, LLC.
  10. Nucor Corp.; Vulcraft Group.
  11. Roof Deck, Inc.
  12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard.
  2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
  3. Deck Profile: As indicated in Structural General Notes.
  4. Cellular Deck Profile: As indicated in Structural General Notes.
  5. Profile Depth: As indicated in Structural General Notes.
  6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.

7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
11. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
  - a. Factory install sound-absorbing insulation into cells of cellular deck.

## **2.4 NONCOMPOSITE VENTED ROOF DECK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ASC Profiles, Inc.; a Blue Scope Steel company.
  2. Canam United States; Canam Group Inc.
  3. CMC Joist & Deck.
  4. Consolidated Systems, Inc.; Metal Dek Group.
  5. Marlyn Steel Decks, Inc.
  6. New Millennium Building Systems, LLC.
  7. Nucor Corp.; Vulcraft Group.
  8. Roof Deck, Inc.
  9. Verco Manufacturing Co.
  10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Roof Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
  1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
  2. Profile Depth: As indicated in Structural General Notes.
  3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
  4. Span Condition: Triple span or more.
  5. Side Laps: Overlapped or interlocking seam at Contractor's option.
  6. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2.

## **2.5 ACCESSORIES**

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
  1. Fasteners shall provide diaphragm shear and uplift resistance equal to or greater than welding indicated herein and on Drawings.

### **3.3 ROOF-DECK INSTALLATION**

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
  1. Weld Diameter: As indicated on Structural Plans.
  2. Weld Spacing: As indicated on Structural Plans.
  3. Weld Washers: Install weld washers at each weld location if deck gauge is lighter than 22 gauge.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals shown on Structural Plans:
  1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  2. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
  1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
  1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: See Section 01 45 23.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

### **3.5 PROTECTION**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
  
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 05 31 00**

## **SECTION 05 40 00 – COLD-FORMED METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Load bearing wall framing.
  2. Exterior nonload bearing wall framing.
  3. Floor joist framing.
  4. Roof rafter framing.
  5. Ceiling joist framing.
  6. Soffit framing.
  7. Accessories necessary for a complete installation.

#### **1.3 RELATED SECTIONS**

- A. Section 05 50 00 – Metal Fabrications.
- B. Section 09 21 16 – Gypsum Board Assemblies.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: General Contractor shall engage a qualified professional engineer, licensed in the State of Texas, to design cold formed steel framing.
- B. Structural Performance: Delegated design engineer shall provide cold-formed steel framing designs capable of withstanding all code required design loads within limits and under conditions indicated on the construction documents and within this specification.
  1. Design Loads: Designs shall be capable of withstanding the worst case loading as indicated on the Structural Drawings, and/or as required by the locally adopted Building Code. The design shall cover the worst case loading in all instances.
  2. Coordinate the requirements on the Structural and Architectural Drawings with the requirements of this Section. If a conflict exists, notations on the Structural Drawings take precedence.
  3. The following document governs the Work, except where more restrictive items are specified:
    - a. AISI Design of Cold-Formed Steel Structural Members Wind Load  
Minimum Design Loads for exterior and/or load bearing and/or soffit applications:
      1. As required by code officials having jurisdiction.
      2. Deflection: 1/600 for clear simple spans
      3. Deflection: 1/300 for cantilever conditions and roof parapets
      4. Gauge: 16 gauge minimum, unless noted otherwise.
    - b. Minimum Design Loads for interior and/or exterior suspended furr-downs with a maximum vertical drop on either side of 5'-0" or greater:
      1. As required by code officials having jurisdiction.
      2. Deflection: 1/600 for clear simple spans
      3. Deflection: 1/300 for cantilever conditions and roof parapets



4. Gauge: 20 gauge minimum, unless noted otherwise.
  5. It is a common practice for studs with thinner than 20 gauge to be crimped and/or ribbed to increase the strength of the overall stud cross section for various loading applications. These studs are typically noted by manufacturer as "Equivalent" to a thicker gauge. These "Equivalent" type studs are not allowed in a vertically suspended application with greater than 5'-0" of vertical wall drop, 20 Gauge is the minimum thickness allowed for these applications.
4. Welding Qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
  5. Studs, tracks, channels, and other light gauge framing members shall conform to requirements of ASTM C955.
  6. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
  7. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (67 degrees C).
  8. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure:
    - a. Upward and downward movement of 1-1/2 inches (38 mm).
  9. Design exterior nonload bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
  2. Wall Studs: AISI S211.
  3. Headers: AISI S212.
  4. Lateral Design: AISI S213.

## 1.5 SUBMITTALS

- A. Product Data: Technical data for cold formed steel framing product and accessories including factory applied primers.
- B. Shop Drawings: Submit layout, spacings, sizes, thickness, and types of cold formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  1. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  2. Shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
- C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations and shop drawings to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations and shop drawings must show design will with stand wind loading commiserate with class and rating of the project.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. Welding Qualifications: Qualify procedures and personnel according to the following:
    - a. AWS D1.1/D1.1M Structural Welding Code - Steel.

- b. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
  - c. CCFSS Technical Bulletin: "AISI Specification Provision for Screw Connections."
2. Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions.
    - a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
  3. Fire Resistance Ratings: ASTM E 119; testing by a UL. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL *Fire Resistance Directory*.
  4. Installer Qualifications: Company specializing in the installation of cold formed metal framing components with minimum five years documented experience.
  5. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
  6. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
  7. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements and galvanized-coating thickness
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold formed metal framing that are similar to those indicated in material, design, and extent.
1. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and structural data.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. CEMCO; California Expanded Metal Products Co.
  2. ClarkDietrich Building Systems.
  3. Consolidated Fabricators Corp.; Building Products Division.
  4. MarinoWARE.
  5. Mill Steel Framing.
  6. SCAFCO Corporation.
  7. The Steel Network.

### 2.2 LOAD BEARING WALL FRAMING

- A. Steel Studs: C shaped steel studs, of web depths indicated, punched, with stiffened flanges:

1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: Refer to the Drawings.
- B. Steel Track: U shaped steel track, of web depths indicated, unpunched, with straight flanges:
1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Flange Width: 1-1/4 inches (32 mm).
- C. Steel Box or Back to Back Headers: C shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges:
1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Flange Width: 1-5/8 inches (41 mm).
- D. Steel Single or Double L Headers: L shapes used to form header beams, of web depths indicated:
1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Top Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: Refer to the Drawings.

### 2.3 EXTERIOR NONLOAD BEARING WALL FRAMING

- A. Steel Studs: C shaped steel studs, of web depths indicated, punched, with stiffened flanges:
1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Flange Width: 1-5/8 inches (41 mm).
  3. Section Properties: Refer to the Drawings.
- B. Steel Track: U shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AllSteel & Gypsum Products, Inc.
    - b. ClarkDietrich Building Systems.
    - c. Marino\WARE.
    - d. SCAFCO Corporation.
    - e. Simpson Strong-Tie Co., Inc.
    - f. Steel Network, Inc. (The).
    - g. Steeler, Inc.
- D. Single Deflection Track: Single, deep leg, U shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure:
1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
  2. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.

- E. Double Deflection Tracks: Double, deep leg, U shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
  - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
    - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
    - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
  - 2. Inner Track: Of web depth indicated:
    - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
    - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- F. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.4 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: C shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges:
  - 1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
  - 2. Flange Width: 2 inches (51 mm), minimum.

## 2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame: C shaped steel sections, of web depths indicated, with stiffened flanges:
  - 1. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm) [0.0538 inch (1.37 mm)].
  - 2. Flange Width: 1-5/8 inches (41 mm) minimum.

## 2.6 FRAMING ACCESSORIES

- A. Fabricate steel framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of appropriate thickness and configuration, unless otherwise indicated:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.
  - 6. Foundation clips.
  - 7. Gusset plates.
  - 8. Stud kickers and knee braces.
  - 9. Joist hangers and end closures.
  - 10. Hole reinforcing plates.
  - 11. Backer plates.
- C. Anchors, Clips, and Fasteners:
  - 1. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot dip process according to ASTM A 123/A 123M.
  - 2. Expansion Anchors: Fabricated from corrosion resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater

- than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
3. Power Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
  4. Mechanical Fasteners: ASTM C 1513, corrosion resistant coated, self-drilling, self-tapping, steel drill screws.
    - a. Head Type: Low profile head beneath sheathing.
  5. Welding Electrodes: Comply with AWS standards.
- D. Miscellaneous Materials:
1. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM A 780.
  2. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, and plasticizing and water reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30 minute working time.
  3. Shims: Load bearing, high density multimonomer plastic, and nonleaching; or of cold formed steel of same grade and coating as framing members supported by shims.
  4. Sealer Gaskets: Closed cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from standard widths to match width of bottom track or rim track members.

## 2.7 FABRICATION

- A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI specifications and standards, manufacturer written instructions, and specified requirements.
1. Fabricate framing assemblies using jigs or templates.
  2. Cut framing members by sawing or shearing; do not torch cut.
  3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
  2. Squareness: Fabricate each cold formed steel framing assembly to a maximum out of square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

### 3.2 PREPARATION

- A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire resistive materials, remove only as much as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below required thickness to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 ERECTION

- A. General:
  - 1. Track Anchors: Install anchors maximum 4 feet - 0 inches on center; design anchors and spacing to carry live, dead and wind loads.
  - 2. Track Splices: Provide channel inserts or weld track splices.
  - 3. Erection: Install members plumb, level, and in a true plane.
  - 4. Fastenings: Make assembly rigid and secure, with welds free of voids and burnouts.
- B. Install metal framing systems in accordance with stud manufacturer's printed instructions.
- C. Runner Tracks:
  - 1. Install continuous tracks sized to match studs.
  - 2. Align tracks accurately to layout at base and tops of studs.
  - 3. Secure tracks as recommended by stud manufacturer, except do not exceed 24 inches on center for nail or power-driven fasteners, nor 16 inches on center for other types of attachment.
  - 4. Provide fasteners at corners and ends of tracks.
  - 5. Tracks shall be anchored to structural steel prior to installing sprayed on insulation.
  - 6. Provide Deflection Track (DT), at top of stud walls at floor or roof above, typically. Allow for 1/2 inch movement of primary structure. Do not attach studs directly to Deflection Track.
  - 7. Vertical Deflection Clips: Provide manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure
- D. Secure studs to top track and bottom runner track by means of approved self-drilling screws or welding at both inside and outside flanges of 14 gauge or heavier material. Screws and welds shall be of sufficient size to insure strength of connection. All welding shall comply with American Welding Society "Specification for Welding Sheet Steel in Structures."
- E. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- F. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Use Zee clips as specified above. Weld "Z" shaped clips to structural members as shown on drawings. Maximum 2 feet on center vertical.

- G. Install supplementary framing, blocking and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.
- H. Frame wall openings with extra studs, equal to the number of studs interrupted by wall openings, placed at each side of wall openings. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.
- I. Install bracing/bridging in accordance with manufacturer's instructions and design conditions.
- J. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.
- K. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- L. Install horizontal stiffeners in stud system, space (vertical distance) at no more than 54 inches on center. Weld at each intersection.

### 3.4 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls:
  - 1. Joist Spacing: 16 inches (406 mm).
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
  - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
  - 1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load bearing interior walls to prevent lateral movement of bottom flange.

- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold down angles, anchors, and fasteners, to provide a complete and stable joist framing assembly.

**END OF SECTION 05 40 00**



## **SECTION 05 50 00 - METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Miscellaneous metal items and their related components which are not necessarily individually described shall be furnished and installed in accordance with the intent of the drawings and specifications and as required to complete the Work.
  - 2. The Work of this Section is governed by Section 05 12 00, Structural Steel, except where more stringent requirements are contained herein or on the Structural Drawings. If a conflict exists, notations on the Structural Drawings take precedence.
- B. Requirements including but not limited to:
  - 1. Steel framing and supports for ceiling hung toilet partitions.
  - 2. Steel framing and supports for operable partitions.
  - 3. Steel framing and supports for overhead doors and grilles.
  - 4. Steel framing and supports for countertops.
  - 5. Steel tube reinforcement for low partitions.
  - 6. Steel framing and supports for mechanical and electrical equipment.
  - 7. CMU Partition Head Support. pi
  - 8. Support angles for elevator door sills.
  - 9. Elevator machine beams, hoist beams, and divider beams.
  - 10. Steel shapes for supporting elevator door sills.
  - 11. Prefabricated building columns.
  - 12. Shelf angles.
  - 13. Metal ladders.
  - 14. Ladder safety cages.
  - 15. Trench drains.
  - 16. Elevator pit sump covers.
  - 17. Miscellaneous steel trim including steel angle corner guards, steel edgings, and loading dock edge angles.
  - 18. Metal bollards.
  - 19. Metal downspout boots.
  - 20. Loose bearing and leveling plates.
  - 21. Loose steel lintels.
  - 22. Accessible or traffic signs posts.
  - 23. Handrails.
  - 24. Steel weld plates and angles for casting into concrete for applications.
  - 25. Accessories necessary for a coordinated and complete installation.

#### **1.3 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and countertop supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Ladders: Provide ladders and landings capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Structural Performance:
  - 1. Countertops: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops:
    - a. All deadloads.
    - b. 500 pound live load placed on the countertop and vanity.
    - c. Deflection at Midspan:  $L/1000$  times span or  $1/8$  inch whichever is less.
- D. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

#### 1.5 SUBMITTALS

- A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.
- B. Shop Drawings: Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
  - 1. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.
- E. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

#### 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements of the IBC for metal fabrications.
  - 2. Welding: Qualify procedures and personnel according to the following:
    - a. AWS D1.1/D1.1M Structural Welding Code - Steel.
    - b. AWS D1.2/D1.2 M Structural Welding Code - Aluminum.
    - c. AWS D1.6/D1.6M Structural Welding Code - Sheet Steel.

- d. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project for a minimum of 5 years, with a record of successful in service performance, with sufficient production capacity to produce required units without causing delay in the Work.
- D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated in material, design, and extent.

### 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

### 1.8 STORAGE, DELIVERY AND HANDLING

- A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated Work.

### 1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other Work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### 1.10 CONTRACTOR'S RESPONSIBILITIES

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and

timely fabrication and installation of the miscellaneous metal items indicated, described, or implied.

- B. As a performance specification, the criteria for the solution of structurally sound miscellaneous metal items indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the miscellaneous metal items are totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design, the decision of the Architect will take precedence.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Rolled Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Rolled Stainless Steel Floor Plate: ASTM A 793.
- G. Abrasive Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. IKG Industries, a division of Harsco Corporation.
    - b. SlipNOT Metal Safety Flooring; W.S. Molnar Company.
- H. Steel Tubing: ASTM A 500/A 500M, cold formed steel tubing.
- I. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- J. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B. with G90 (Z275) coating; [0.108 inch (2.8 mm) nominal thickness.
  - 3. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
  - 4. Width of Channels: 1-5/8 inches (41 mm).

5. Depth of Channels: Indicated on Drawings.
  6. Metal and Thickness: Galvanized steel complying with ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8mm) nominal thickness.
  7. Finish: Hot dip galvanized after fabrication.
- K. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- L. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- M. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- N. Aluminum Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- O. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- P. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum.
  2. Provide stainless steel fasteners for fastening stainless steel.
  3. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  4. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
  5. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy.
  6. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
    - a. Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
  7. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  8. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F 2329.
  9. Post Installed Anchors: chemical anchors.
    - a. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
    - b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
  10. Slotted Channel Inserts: Cold formed, hot dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches

(200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

Q. Miscellaneous Materials:

1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
7. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
8. Concrete Materials and Properties: Composed of ASTM C150 Type I Portland cement, ASTM C33 sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8" with at least 95 % passing a 3/8" sieve and not more than 10% passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28 day compressive strength of 3000 psi (20 MPa).

## 2.2 FABRICATION

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
1. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
  2. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.
  3. Form exposed Work with accurate angles and surfaces and straight edges.
  4. Weld corners and seams continuously to comply with the following:
    - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - b. Obtain fusion without undercut or overlap.
    - c. Remove welding flux immediately.
    - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
  5. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
  6. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

7. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
  8. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
  9. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.
- B. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the Work and which are not a part of the structural framework, including but not limited to framing and supports for elevator hoistway beams, elevator sills, overhead lobby door frames, sliding doors, countertop, ceiling hung toilet compartments, and tube framing for partial height walls, CMU partition head supports, mechanical and electrical equipment.
1. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
    - a. Fabricate units from slotted channel framing where indicated.
    - b. Furnish inserts for units installed after concrete is placed.
  2. Folding Panel Partitions: Fabricate Concrete filled supports for Folding Panel partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on Folding Panel partition Shop Drawings.
  3. Framing for Ceiling Hung Toilet Compartments: Provide framing for ceiling hung toilet compartments, coordinated with the partitions and including provisions for partition anchorage as required to sustain imposed loads and to limit deflections to L/360 between hangers, fabricated from the following.
    - a. Structural Steel Shapes, Plates and Bars: ASTM A36/A36M.
    - b. Modular Structural Framing System: ASTM A569; modular, structural quality steel preformed U channel framing system with continuous open slot prepared to receive attachment nuts, bolts, straps, threaded rods, beam clamps, hanger rods support brackets and other accessories. Provide corrosion resistant finish.
    - c. Provide steel rods, 1/2 inch (13 mm) diameter, spaced at maximum 36 inches (900 mm) o.c. Thread rods to receive anchor and stop nuts. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
    - d. Coordinate installation with toilet compartment manufacturer's written instructions and recommendations.
  4. Countertop Framing: Custom fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce Work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the Work.
  5. CMU Partition Head Supports: Fabricate supports from 4" x 4" x 1/4" x 36" (100 mm by 100 mm by 6 mm by 900 mm) long structural steel angles. Drill supports a maximum of 12 inches (300 mm) o.c. to receive expansion bolts.
  6. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

7. Steel Pipe Columns: Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
  - a. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
  - b. Unless otherwise indicated, provide 1/2 inch (12.7 mm) baseplates with four 5/8 inch (16 mm) anchor bolts and 1/4 inch (6.4 mm) top plates.
  - c. Galvanize miscellaneous framing and supports.
  
- C. Handrails and Brackets:
  1. Steel Pipe Handrails and Brackets: Furnish and install 1-1/2 inch O.D. Schedule 40 steel pipe rails for outdoor stairs and ramps, unless noted otherwise. Brackets shall be wall type. Include all other components required for finished installation. All work shall comply with local codes and Texas Accessibility Standards (TAS). Hot dip galvanized all components after fabrication.
  2. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
  
- D. Shelf Angles: Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4 inch (19 mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
  1. Provide mitered and welded units at corners.
  2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
  3. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
  4. Galvanize and prime shelf angles located in exterior walls.
  5. Prime shelf angles located in exterior walls with zinc rich primer.
  6. Furnish wedge type concrete inserts, complete with fasteners, to attach shelf angles to cast in place concrete.
  
- E. Ladders: Comply with ANSI A14.3. For elevator pit ladders, comply with ASME A17.1/CSA B44
  1. Steel Ladders:
    - a. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
    - b. Siderails: Continuous, 1/2 inch by 2-1/2 inch (12.7 mm by 64 mm) steel flat bars, with eased edges.
    - c. Rungs: 1 inch (25 mm) diameter steel bars.
    - d. Fit rungs in centerline of siderails; plug weld and grind smooth on outer rail faces.
    - e. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum oxide granules set in epoxy resin adhesive or by using a type of manufactured rung filled with aluminum oxide grout.
    - f. Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung.
      - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a) Harsco Industrial IKG, a division of Harsco Corporation.
        - b) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
    - g. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. welded.
    - h. Galvanize ladders, welded.



- F. Ladder Safety Cages: Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless steel fasteners.
  - 1. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.
  - 2. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless steel fasteners unless otherwise indicated.
  - 3. Steel Ladder Safety Cages:
    - a. Primary Hoops: 1/4 inch by 4 inch (6.4 mm by 100 mm) flat bar hoops.
    - b. Secondary Intermediate Hoops: 1/4 inch by 2 inch (6.4 mm by 50 mm) flat bar hoops.
    - c. Vertical Bars: 3/16 inch by 1-1/2 inch (4.8 inch by 38 mm) flat bars secured to each hoop.
    - d. Galvanize ladder safety cages, including brackets and fasteners.
    - e. Prime ladder safety cages, including brackets and fasteners, with zinc rich primer.

### 2.3 TRENCH DRAINS

- A. Provide 304L stainless steel, non-porous linear drain top grates.
- B. Basis of Design: S-DG 65 Series as manufactured by Infinity Drain, (516) 767-6786.
- C. Physical Properties:
  - 1. Channel: PVC Channel.
  - 2. Flow rate: 16 gpm per outlet.

### 2.4 MISCELLANEOUS STEEL TRIM

- A. Miscellaneous Steel Trim: Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
  - 1. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other Work.
    - a. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c.
  - 2. Cast in Pit Angles and Edge Angles: Provide edge angles, and pit angles, fabricated from angles of size as shown, or required, with welded on stud anchors spaced 24 inches (600 mm) on center. Provide pit and edge angles in as long lengths as possible. Miter and weld corners and provide splice plates for alignment between sections.
  - 3. Galvanize miscellaneous steel trim.

### 2.5 P[PIPE] [DOWNSPOUT] GUARDS

- A. Fabricate **[pipe] [downspout]** guards from 3/8 inch (9.5 mm) thick by 12 inch (300 mm) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2 inch (50 mm) clearance between pipe and pipe guard. Drill each end for two 3/4 inch (19 mm) anchor bolts.
- B. Galvanize and prime **[pipe] [downspout]** guards.

## **2.6 PIPE BOLLARDS**

- A. Pipe Bollards: Fabricate metal bollards from Schedule 40 steel pipe or 1/4 inch (6.4 mm) wall thickness rectangular steel tubing.
1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
  3. Where installation on structural slab or existing paving, fabricate bollards with 3/8 inch (9.5 mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch (19 mm) anchor bolts.
    - a. Where bollards are anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
  4. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4 inch (6.4 mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.
  5. All pipe bollards are to be hot dipped galvanized.

## **2.7 LOOSE BEARING AND LEVELING PLATES**

- A. Loose Bearing and Leveling Plate: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
1. Galvanize plates.

## **2.8 LOOSE STEEL LINTELS**

- A. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
1. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
  2. Galvanize and prime loose steel lintels located in exterior walls.

## **2.9 STEEL WELD PLATES AND ANGLES**

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## **2.10 FLOOR HATCH**

- A. Floor Hatch: Provide single leaf aluminum plate floor hatch.
1. Frame: 1/4 inch extruded aluminum with built in neoprene cushion, with strap anchors bolted to exterior.
  2. Door: 1/4 inch aluminum diamond plate reinforced with aluminum stiffeners as required. Bolt cast steel hinges to underside and pivot on torsion bars. Fabricate door to open to 90 degrees and lock automatically in position. Provide a vinyl grip handle. Construct door withstand minimum live load of 150 lbs. per sq. ft.
  3. Factory finish: Aluminum lacquer, and a bituminous coating applied to exterior of the frame.

### **2.11 ACCESSIBLE OR TRAFFIC SIGN POST**

- A. Accessible Parking Sign Posts: 2 inch by 12 inch galvanized steel tube with integral welded galvanized post cap, painted in color selected by Architect.
  - 1. Post Anchor Bolts: Two (2) galvanized 1/2 inch by 6-1/8 inch Nelson stud anchor bolts welded to steel tube front and back.
  - 2. Signs: Refer to Section 10 14 00 – Graphics.

### **2.12 MOUNTING POST**

- A. Door Device Mounting Post
  - 1. Mounting post for (card reader) (and) (door activation button):
    - a. Basis of Design: "ADA-Stainless-Bollard-48x5RxP" as manufactured by Pedestal PRO.
    - b. Finish: Brushed stainless steel.
- B. Traffic Signage Mounting Post
  - 1. Post: 2-3/8 inch diameter galvanized steel.
  - 2. Height as indicated on Drawings.

### **2.13 FABRICATION TOLERANCES**

- A. Squareness: 1/8 inch (3mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5mm).
- D. Maximum Bow: 1/8 inch (3mm) in 48 inches (1.2m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5mm) in 48 inches (1.2m).

### **2.14 FINISHES**

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surfaces.

### **2.15 STEEL AND IRON FINISHES**

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- F. Stainless Steel Finishes: Remove tool and die marks and stretch lines or blend into finish.
1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
  2. Bright, Directional Polish: No. 4 finish.
  3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## **2.16 ALUMINUM FINISHES**

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
1. 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### **3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS**

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for ceiling hung toilet partitions, operable partitions, overhead doors, and overhead grilles securely to, and rigidly brace from, building structure.
  - 1. Ceiling Hung Toilet Partitions: Anchor supports securely to, and rigidly brace from, overhead building structure.
  - 2. CMU Partition Head Supports: Unless otherwise indicated place partition head supports on alternate faces of CMU partitions every 6 feet o.c. and expansion bolt to underside of structure. Do not bolt to CMU partitions.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### **3.3 INSTALLING PREFABRICATED BUILDING COLUMNS**

- A. Install prefabricated building columns to comply with AISC 360, "Specifications for Structural Steel Buildings," and with requirements applicable to listing and labeling for fire-resistance rating indicated.

### **3.4 INSTALLING METAL BOLLARDS**

- A. Fill metal capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  - 1. Do not fill removable bollards with concrete.

### **3.5 INSTALLING RAILINGS**

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
  - 1. Anchor posts to steel by welding to steel supporting members.
  - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

- B. Attach handrails to wall with wall brackets. Locate brackets at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.

### **3.6 INSTALLING BEARING AND LEVELING PLATES**

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### **3.8 ERECTION TOLERANCES**

- A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.
- B. Maximum Offset from True Alignment: 1/4 inch (6mm).
- C. Maximum Out of Position: 1/4 inch (6mm).

### **3.9 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

**END OF SECTION 05 50 00**

## **SECTION 05 51 00 - STEEL STAIRS, HANDRAILS, AND RAILINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Preassembled steel stairs.
  2. Treads, concrete filled and steel.
  3. Steel tube handrails and railings.
  4. Accessories necessary for a complete installation.

#### **1.3 RELATED SECTIONS**

- A. Section 03 30 00 – Cast-In-Place Concrete.
- B. Section 05 52 13 – Pipe and Tube Railings.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of steel stairs and railings to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
  2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
  3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
  5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. Component Importance Factor: 1.5.

## 1.5 SUBMITTALS

- A. Product Data: Technical data for metal pan stairs and the following:
  - 1. Prefilled metal pan stair treads.
  - 2. Precast concrete treads.
  - 3. Epoxy resin filled stair treads.
  - 4. Nonslip aggregates and nonslip aggregate finishes.
  - 5. Abrasive nosings.
  - 6. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type and finish of nosing and tread.
- D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Welding certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Welding Qualifications: Qualify procedures and personnel according to the following:
    - a. AWS D1.1/D1.1M Structural Welding Code - Steel.
    - b. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- B. Installer Qualifications: Fabricator of products, having minimum of 5 years documented experience in the fabrication and installation of metal stairs.

## 1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alfab, Inc.
  - 2. American Stair, Inc.
  - 3. Lapeyre Stair Inc.



4. Pacific Stair Corporation.
  5. Worthington Metal Fabricators.
- B. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- F. Uncoated, Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- G. Uncoated, Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- H. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.
- I. Expanded Metal, Carbon Steel: ASTM F 1267, Class 1 (uncoated).
- J. Perforated Metal: Cold rolled steel sheet, ASTM A 1008/A 1008M, or hot rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B.
- K. Perforated Metal: Galvanized steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B.
- L. Woven Wire Mesh: Intermediate crimp, 2 inch (50 mm) woven wire mesh, made from 0.135 inch (3.5 mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).
- M. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- N. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- O. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- P. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- Q. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- R. Abrasive Nosings
1. Cast Metal Units: Cast aluminum, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) American Safety Tread Co., Inc.
      - 2) Barry Pattern & Foundry Co., Inc.
      - 3) Granite State Casting Co.
      - 4) Nystrom, Inc.

- 5) Safe-T-Metal Company, Inc.
      - 6) Wooster Products Inc.
    - b. Configuration: Cross-hatched units, 3 inches (75 mm) wide without lip.
    - c. Thickness: 3/8 inch.
  2. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) ACL Industries, Inc.
      - 2) American Safety Tread Co., Inc.
      - 3) Amstep Products.
      - 4) Armstrong Products, Inc.
      - 5) Granite State Casting Co.
      - 6) Nystrom, Inc.
      - 7) Wooster Products Inc.
    - b. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
    - c. Provide solid abrasive type units without ribs.
    - d. Thickness: 3/8 inch.
  3. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
  4. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
  5. Apply clear lacquer to concealed surfaces of extruded units set into concrete.
- S. Fasteners: Provide zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
  1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  2. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
    - a. Provide mechanically deposited or hot dip, zinc coated anchor bolts.
  3. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
    - a. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
    - b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [**Group 1 (A1)**] [**Group 2 (A4)**] stainless steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- T. Miscellaneous Materials:
  1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company or comparable product approved by Architect.

2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
  3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
  4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
  5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
  6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
  7. Concrete Materials and Properties: Comply with requirements in Section 033000 for normal weight, air entrained, ready mix concrete with a minimum 28 day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
  8. Nonslip Aggregate Concrete Finish: Factory packaged abrasive aggregate made from fused, aluminum oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
  9. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.
- U. Precast Concrete Treads:
1. Concrete Materials and Properties: Comply with requirements in Section 033000 for normal weight, ready mixed concrete with a minimum 28 day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.
  2. Reinforcement: Galvanized, welded wire reinforcement, 2 inches by 2 inches (50 mm by 50 mm) by 0.062 inch (1.6 mm) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

## 2.2 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, [ railings,] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
1. Join components by welding unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
  4. Weld exposed corners and seams continuously unless otherwise indicated.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

## 2.3 STEEL FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with *Recommended Voluntary Minimum Standards for Fixed Metal Stairs* in NAAMM AMP 510 *Metal Stairs Manual*, unless more stringent requirements are indicated.
- B. Stair Framing:
1. Fabricate stringers of steel plates or channels.
    - a. Provide closures for exposed ends of channel stringers.
  2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
  3. Weld stringers to headers; weld framing members to stringers and headers.
  4. Where stairs are enclosed by gypsum board shaft wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire resistance rated stair enclosure.
  5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
1. Steel Sheet: Uncoated **cold** rolled steel sheet unless otherwise indicated.
  2. Steel Sheet: Galvanized steel sheet, where indicated.
  3. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
  4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  5. Shape metal pans to include nosing integral with riser.
  6. Attach abrasive nosings to risers.
  7. Provide subplatforms of configuration the same as subtreads. Weld subplatforms to platform framing.
    - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

## 2.4 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing: Hot dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  2. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 *Power Tool Cleaning*.

- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel for shop painting.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLING METAL PAN STAIRS**

- A. Fastening to In Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- G. Install precast concrete treads with adhesive supplied by manufacturer.

#### **3.2 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

**END OF SECTION 05 51 00**

## **SECTION 05 52 00 – METAL RAILINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Steel pipe and tube railings.
  - 2. Accessories necessary for a complete installation.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C, material surfaces).

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for railings and the following:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Fittings and brackets.
  - 3. Assembled Sample of railing system, made from full size components, including top rail, post, handrail, and infill. Sample need not be full height.
    - a. Show method of connecting and finishing members at intersections.

- D. Delegated design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For testing agency.
- F. Mill Certificates: Signed by manufacturers of stainless steel products certifying that products furnished comply with requirements.
- G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- H. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- I. Evaluation Reports: For post installed anchors, from ICC-ES.

### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable provisions of the IBC for railings.
  - 2. Welding Qualifications: Qualify procedures and personnel according to the following:
    - a. AWS D1.1/D1.1M Structural Welding Code - Steel.
    - b. AWS D1.2/D1.2M Structural Welding Code - Aluminum.
    - c. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

### **1.6 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### **1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following
  - 1. Steel Pipe and Tube Railings:
    - a. Hybrid Fab; (832) 203-7180.
    - b. Wagner, R & B, Inc.
    - c. Julius Blum & Co, Inc.
    - d. Comparable product approved by Architect.
  
- B. Railing System:
  - 1. Handrails: 1-1/2 inch O.D.
  - 2. Pickets: 1-1/4 inch O.D.
  - 3. Round pickets at 4 inch O.C.
  - 4. Intermediate Rail: 1-5/8 inch round.
  - 5. Top Rail: 1-5/8 inch round.
  - 6. Bottom Rail: 1-5/8 inch round.
  
- C. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
  
- D. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2 inch (38 mm) clearance from inside face of handrail to finished wall surface.
  
- E. Steel and Iron:
  - 1. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
  - 2. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
    - a. Provide galvanized finish for exterior installations and where indicated.
  - 3. Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 4. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
  
- F. Fasteners: Provide the following:
  - 1. Hot Dip Galvanized Railings: Type 304 stainless steel or hot dip zinc coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
  - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
  - 3. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
  - 4. Fasteners for Interconnecting Railing Components:
    - a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
    - b. Provide flat head machine screws for exposed fasteners unless otherwise indicated.
  
- G. Miscellaneous Materials:
  - 1. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 2. Etching Cleaner for Galvanized Metal: Complying with MPI#25.



3. Galvanizing Repair Paint: High zinc dust content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
4. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
5. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
6. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
7. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
8. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
9. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.2 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove flux immediately.
  4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form Changes in Direction:
  - 1. By radius bends of radius indicated] [or] [by inserting prefabricated elbow fittings of radius indicated.
- L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

## 2.3 FINISHES

- A. Steel and Iron Finishes:
  - 1. Galvanized Railings:
    - a. Hot dip galvanize steel railings, including hardware, after fabrication.
    - b. Comply with ASTM A 123/A 123M for hot dip galvanized railings.
    - c. Comply with ASTM A 153/A 153M for hot dip galvanized hardware.
    - d. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
    - e. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
  - 3. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
  - 4. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 *Shop, Field, and Maintenance Painting of Steel* for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 5. Do not apply primer to galvanized surfaces.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

#### **3.2 INSTALLATION**

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in place construction.

#### **3.3 RAILING CONNECTIONS**

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

#### **3.4 ANCHORING POSTS**

- A. Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

- B. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members:
  - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- C. Install removable railing sections, where indicated, in slip fit metal sockets cast in concrete.
  - 1. Finish: Galvanized.

### **3.5 ATTACHING RAILINGS**

- A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled in expansion shields and hanger or lag bolts.

### **3.6 ADJUSTING AND CLEANING**

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

### **3.7 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION 05 52 00**

## **SECTION 05 75 00 - DECORATIVE FORMED METAL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes
  1. Edge-protection and transition profiles for floors.
  2. Finishing and edge-protection profiles for walls and countertops.
  3. Movement joint and cove-shaped profiles.
  4. Decorative reveals.
  5. Mirror Trim.

#### **1.3 REFERENCES**

- A. Tile Council of North America (TCNA) Handbook for Ceramic Tile Installation
- B. Terrazzo, Tile and Marble Association of Canada (TTMAC) Specification Guide 09300 Tile Installation Manual
- C. American National Standard Specifications for the Installation of Ceramic Tile A108 / A118 / A136.1

### **PART 2 - PRODUCTS**

#### **2.1 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS**

- A. Specifications are based on the products identified as Basis of Design. Listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 01 requirements regarding substitutions to be considered.
  1. C.R. Laurence Co., Inc.
  2. Fry Reglet Corporation.
  3. McNichols.
  4. Schluter Systems.
  5. Tarkett.
- B. Decorative Grille (DG)
  1. Basis of Design: McNichols.
  2. Material: Aluminum.
  3. Thickness: 0.320" (20 gauge).
  4. Style: Designer Perforated, hexagonal, honeycomb 2079.
  5. Size: Refer to Drawings.
  6. Finish: Power Coat.
  7. Color: Architect to select from Manufacturer's full range of colors.

#### **2.2 FLOORING TRANSITION**

- A. Decorative Flooring Transition (TR1):

1. Basis of Design: Metal Edge as manufactured by Tarkett.
2. Type: Resilient flooring to carpet joiner.
3. Color: Iron Stone.

### **2.3 DECORATIVE WALL REVEALS**

- A. Decorative Reveal, Type 1 (DR-1)
  1. Basis of Design: Fry Reglet®-DRM-625-50, Non-Vented
  2. Description: Decorative reveal
    - a. Reveal Depth: 5/8"
    - b. Reveal Width: 1/2"
  3. Material: Aluminum
    - a. Finish: Clear anodized

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- A. Consult Schluter®-Systems' current technical literature for proper design and installation instructions.

**END OF SECTION 05 75 00**

## **SECTION 06 10 00 - ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. All rough carpentry items including, but not limited to:
  - 1. Wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support.
  - 2. Wood cants, nailers, curbs, and other items associated with roofing work.
  - 3. Miscellaneous framing items and plywood sheathing.

#### **1.3 RELATED WORK**

- A. All Sections of Work supported on or recessed into wood framing or requiring wood blocking for support, such as wall trim, wall cabinets, handrails, lockers, toilet compartments, toilet and bath accessories, classroom technology, graphics. Signage markerboards, tackboards, projection screens, fire extinguisher cabinets, etc., as applicable to the Project. Metal plate blocking is not allowed.

#### **1.4 SUBMITTALS**

- A. Product Data: Manufacturer's data on wood treatment materials to include any MSDS sheets.

#### **1.5 WARRANTY**

- A. Provide contractor/ product one-year warranty from substantial completion date.

#### **1.6 STANDARDS AND GRADING**

- A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization approved by the Architect, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.
- B. Each piece of plywood used shall carry the American Plywood Association trademark.
- C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.
- D. Reference Standards: Conform with all requirements.
  - 1. U.S. Dept. of Commerce Product Standards (PS)
  - 2. American Plywood Association (APA)
    - a. Standards and Construction Guide.
  - 3. American Wood Preservers Association (AWPA)
    - a. Standards, as they apply.
  - 4. Architectural Woodwork Institute (AWI)
    - a. "Quality Standards."

5. National Woodwork Manufacturers' Association (NWMA)
6. Standards.Western Wood Products Association (WWPA)
  - a. Manual.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Lumber:
  1. Treated No. 2, S4S Southern Yellow Pine, #1 kiln dried.
    - a. Comply with NWMA Standards
    - b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.
  2. No. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.
  3. Fire Retardant No, 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.
- B. Plywood:
  1. General: Comply with APA Standards.
  2. APA A-D, Group 1 Interior used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closets and telephone boards in mechanical and telephone rooms where shown or required. 3/4 inch thick unless required or shown otherwise. Paint as scheduled in Section 09 91 00.
  3. Exterior plywood, Group 1, APA rated sheathing. Use where miscellaneous plywood is exposed to concrete, weather, or at roof construction as sheathing.
  4. Fire Retardant Treated Plywood: Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.
  5. Underlayment: If shown or required, APA rated Sturdi-floor, exterior grade, tongue and groove edges.
  6. MDF/ IDF Closet: Provide one (1) 4 foot by 8 foot painted 3/4 inch fire treated plywood on all walls from floor to 8 foot AFF. Plywood to be held a minimum of 1 inch from floor.
- C. Rough Hardware:
  1. Nails, Spikes, and Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
  2. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
  3. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry and concrete. Bolts or power activated type for anchorage to steel.
- D. Wood Treatment:
  1. Preservative Treatment (Concealed Conditions):
    - a. Borate: Pressure impregnate preservative to net retention of 0.28 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards:
      - 1) Preservative Treatment Standard: AWWA P5\
      - 2) Structural Lumber Treatment Standard: AWWA C31

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- 3) Plywood Treatment Standard: AWWA C9
  - b. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.
  - c. Provide Quality Mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
  - d. Concealed conditions mean conditions that are interior, above ground that are not exposed to direct standing water, in contact with natural grade, or exposed to weather.
  - e. ACQ and CCA preservatives not permitted.
  - f. Acceptable Manufacturers: Osmose "Advance Guard"; Universal Forest Products "Prowood Borate"; or Architect approved equal.
2. Fire Retardant Treatment:
  - a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWWA Standard C20.
  - b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWWA Standards C27.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Wood Framing:
  1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
  2. Spiking and nailing shall be done using largest size spikes and nail practicable.
  3. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. with 4 inch face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
  4. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.
  5. Provide blocking, bucks and framing as necessary and for other trades as required.
  6. Drill lumber accurately for bolts and fit all bolts with suitable washers.
- B. Plywood:
  1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
  2. Install underlayment plywood as shown in accordance with instructions of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six (6) inches at edges and eight (8) inches in field each way.

**END OF SECTION 06 10 00**

## **SECTION 06 16 00 - SHEATHING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Wall sheathing.
  2. Underlayment.
  3. Sheathing joint and penetration treatment.
  4. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details.
  1. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
  2. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
  3. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
  4. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
  5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

#### **1.4 QUALITY ASSURANCE**

- A. Fire Test Response Characteristics: For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Fire Resistance Ratings: Indicated by design designations from UL *Fire Resistance Directory* or GA-600 *Fire Resistance Design Manual*.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Plywood: DOC PS 1.
- B. Oriented Strand Board: DOC PS 2.
- C. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

### **2.2 PRESERVATIVE TREATED PLYWOOD:**

- A. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

### **2.3 FIRE RETARDANT TREATED PLYWOOD**

- A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire Retardant Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.
- C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.

- E. Application: Treat plywood indicated on Drawings and the following:
  - 1. Roof and wall sheathing within 48 inches (1220 mm) of fire walls.
  - 2. Subflooring and underlayment for raised platforms.

## 2.4 WALL SHEATHING

- A. Glass Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
  - 1. Product: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; GlasRoc.
    - b. G-P Gypsum Corporation; Dens-Glass Gold.
    - c. National Gypsum Company; Gold Bond e(2)XP.
    - d. United States Gypsum Co.; Securock.
  - 2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
  - 3. Size: 8 by 96 inches (1219 by 2438 mm) for vertical installation.
- B. Alternative: Air- and Water-Resistive Sheathing Board: ASTM C1177/C1177M, glass-mat-faced gypsum sheathing board.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensElement Barrier System or comparable product.
  - 2. Board Thickness: 5/8 inch (15.9 mm) thick.
  - 3. Board Type: Type X.
  - 4. Board Size: 48 by 96 inches (1219 by 2438 mm) for vertical and horizontal installations.
  - 5. Air- and Water-Resistive Flashing Thickness: Minimum 16 mil (0.41 mm) wet film thickness.
  - 6. Physical and Performance Properties:
    - a. Air Permeance; ASTM E2178: Maximum 0.004 cfm/sq. ft. (0.02 L/s x sq. m) of surface area at 1.57 lbf/sq. ft. (75 Pa) pressure difference.
    - b. Water Vapor Permeance: 25 perms (1436 ng/Pa x s x sq. m) or more when tested in accordance with ASTM E96/E96M, Procedure B.
    - c. Combustion Characteristics; ASTM E84: Class A.
    - d. Board Product Antifungal Properties; ASTM D3273: 10; zero defacement.
    - e. VOC Content - Fluid-Applied Flashing: 50 g/L or less.
    - f. UV and Weathering Resistance: Maximum 12-month exposure.
  - 7. General: Provide compatible air barrier accessory materials furnished or in accordance with air barrier manufacturer's written instructions as required by Project conditions to produce a complete air barrier assembly identical to tested assemblies meeting performance requirements.
  - 8. Joint Backing: See Section 07 92 00 "Joint Sealants" for backing materials.
  - 9. Fluid-Applied Air Barrier Flashing: Site-applied for application to joints, fasteners, penetrations, openings, and material transitions.
    - a. Pacific Gypsum LLC; DensDefy Liquid Flashing.
    - b. Color: Gold.
  - 10. Flashing and Transition Strip: self-adhered membrane, 25 mils (0.64 mm) thick.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensDefy Transition Membrane.
  - 11. Screws for Fastening Board Product Air Barriers to Cold-Formed Metal Framing: Steel drill screws, ASTM C1002, in length in accordance with sheathing manufacturer's written instructions for sheathing thickness.
- H. Screws for Fastening Board Product Air Barriers to Wood Framing: Wood screws, ASTM C1002, in length in accordance with sheathing manufacturer's written instructions for sheathing thickness.

## 2.5 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged single floor panels.
  - 1. Span Rating: Not less than 20 o.c.
  - 2. Nominal Thickness: Not less than 1 inch (25 mm).
  - 3. Edge Detail: Tongue and groove.
  - 4. Surface Finish: Fully sanded face.
  
- B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.
  
- C. Sound Deadening Board: Class C fire rated, molded, recycled post-consumer paper, cellulose fiber structural panel.
  - 1. Density: 26 pcf to 28 pcf (416 = 448 kg/cu.m) tested in accordance with ASTM C209.
  - 2. Tensile Strength: When tested in accordance with ASTM C209"
    - a. Parallel: 450 - 700 psi (3100 - 4,830 kPa).
    - b. Transverse: 750 - 1--- psi (5.1171 - 6.894 kPa).
  
  - 3. Hardness (Janka Ball): 230 lbs (104 kg) tested in accordance with AST D1037.
  - 4. Water Absorption by Volume: When tested in accordance with ASTM C209.
    - a. 2 Hour Immersion: Maximum 7 percent.
  
  - 5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
  - 6. Noise Reduction Coefficient (NCR): 0.20.
  - 7. Flame Spread: Maximum 75 tested in accordance with ASTM E84 Class C.
  - 8. Thickness: 3/4 inch (19 mm).

## 2.6 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A 153/A 153M.
  
- B. Nails, Brads, and Staples: ASTM F 1667.
  
- C. Power Driven Fasteners: NES NER-272.
  
- D. Wood Screws: ASME B18.6.1.
  
- E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B 117.
  - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.

## 2.7 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in service use.

## **2.8 MISCELLANEOUS MATERIALS**

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with Table 2304.10.1 Fastening Schedule in ICC *International Building Code*.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### **3.2 GYPSUM SHEATHING INSTALLATION**

- A. Comply with GA-253 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8 inch (9.5 mm) gap where nonload bearing construction abuts structural elements. Install boards with a 1/4 inch (6.4 mm) gap where they abut masonry or similar materials that retains moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
  1. Space fasteners approximately 7 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

- D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

**END OF SECTION 06 16 00**

## **SECTION 07 16 00 - BELOW GRADE WATERPROOFING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Preparation of concrete surfaces to receive waterproofing membrane.
- B. Sealing of cracks and joints.
- C. Fluid applied waterproofing system, with prefabricated drainage composite or protection board at walls that fall below grade (auditorium, basement, elevator pit, etc.).
- D. Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.

#### **1.2 RELATED SECTIONS**

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 07 92 00 - Building Sealants
- C. Division 23 - Mechanical: Mechanical penetrations, such as floor drains and piping, through waterproofing membrane.
- D. Division 26 - Electrical: Electrical penetrations, such as conduit, through waterproofing membrane.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Certifications:
  - 1. Manufacturer's certification that applicator is approved by Manufacturer.
  - 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
- C. Warranty: Submit a sample warranty identifying the terms and conditions stated in warranty.

#### **1.4 QUALITY ASSURANCE**

- A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system Manufacturer.
- B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).



**1.5 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 – Project Coordination

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials job site in original, factory-sealed, unopened containers bearing Manufacturer's name and label intact and legible with following information.
  - 1. Name of material.
  - 2. Manufacturer's stock number and date of manufacture.
  - 3. Material safety data sheet (MSDS).
- B. Store and handle in strict compliance with Manufacturer's instructions, recommendations and material safety data sheet (MSDS).
- C. Protect from damage from sunlight, weather, excessive temperatures and construction operations.
- D. Remove damaged material from the site and dispose of in accordance with applicable regulations.
- E. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides.
- F. Store drainage composite and protection board flat and off the ground. Provide cover on top and all sides.
- G. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.
- H. Sequence deliveries of materials to avoid delays but minimize on-site storage.

**1.7 PROJECT CONDITIONS**

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the Manufacturer of the materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.
- C. Coordinate waterproofing work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.
- D. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.
- E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.
- F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.

- G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

**1.8 WARRANTY**

- A. Warrant the work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

**PART 2 - PRODUCTS**

**2.1 FLUID APPLIED WATERPROOFING SYSTEM - POST APPLIED**

- A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Membrane 500)
  - 2. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (Barricoat)
  - 3. GCP Applied Technologies, Cambridge, MA (Procor)
  - 4. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol LM)
- B. Fluid Applied Waterproofing Membrane: Water-based rubber and / or bitumen liquid / fluid applied waterproofing membrane modified with high performance rubberized polymers and special additives for use in vertical seamless applications.

Waterproofing Membrane Physical Properties, minimum:

<b>Property</b>	<b>Test Method</b>	<b>Typical Value</b>
Cured / Dry Film Thickness	ASTM D3767	60 mils
Solids Content	---	62%
Low Temp Flexibility	ASTM C836	Pass
Elongation	ASTM D412	500%
Pliability	ASTM D1970	Unaffected
Resistance to Standing Water	ASTM D2939	Pass

- C. Accessory Products:
  - 1. Protection Course: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cusped under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.
- D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

**2.2 SHEET APPLIED WATERPROOFING SYSTEM - POST APPLIED**

- A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (MiraDRI 860/861)
  - 2. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol)

- B. Sheet Applied Waterproofing Membrane: Self-adhering sheet membrane consisting of rubberized asphalt laminated to a polyethylene film.

Waterproofing Membrane Physical Properties, minimum:

<u>Property</u>	<u>Test Method</u>	<u>Typical Value</u>
Thickness	ASTM D3767	60 mils
Low Temp Flexibility	ASTM D1970	Pass
Elongation	ASTM D412	350%
Puncture Resistance	ASTM E154	50 lbf
Hydrostatic Head	ASTM D5385	230 ft

- C. Accessory Products:
  1. Primer: Manufacturer’s recommended spray or roller applied water-based adhesive.
  2. Detail Sealant: Manufacturer’s recommended sealant material for use at penetrations, cut edges, top edge terminations, transitions, etc. and adhesion for the protection course.
  3. Detail Strip: Manufacturer’s recommended waterproofing membrane material.
  4. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cusped under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.
  5. Termination Bar: High strength, pre-formed, multi-purpose plastic strip with holes 6” o.c.
- D. Locations: Vertical and horizontal below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0’-0” and where shown on drawings.

**2.3 SHEET APPLIED WATERPROOFING SYSTEM - PRE-APPLIED**

- A. Specifications are based on named Manufacturer’s products and systems listed below. Other Manufacturers must have a minimum of five (5) years’ experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Skin 550G)
  2. GCP Applied Technologies, Cambridge, MA (Preprufe 200)
- B. Sheet Waterproofing Membrane: Composite sheet comprising a heavy duty, puncture resistant, HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure.
- C. Accessory Products:
  1. Pressure Sensitive Tape: Two-sided, reinforced, pressure sensitive tape constructed with a highly aggressive adhesive. Material to form a continuous and integral seal to the structure (GCP Preprufe CJ Tape).
  2. Detail Sealant: Manufacturer’s approved sealant intended for use sealing around penetrations.
- D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas as well as horizontal surfaces below the slab that fall below grade 0’-0” and where shown on drawings.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Before waterproofing work is started the all surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

#### **3.2 SURFACE PREPARATION**

- A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry and free from all surface contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.
- B. Repair all cracks in accordance with Manufacturer's instructions.

#### **3.3 APPLICATION**

- A. Priming: Shall be in accordance with membrane Manufacturer's instructions.
- B. Apply waterproofing in accordance with membrane Manufacturer's instructions.
- C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the Manufacturer.
- D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install Manufacturer's recommended drainage composite or protection board / protection course on remainder.

**END OF SECTION**

## **SECTION 07 21 00 - THERMAL INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Double layer, roofing insulation system.
  2. Extruded polystyrene foam board
  3. Polyisocyanurate foam plastic board.
  4. Thermal insulation.
  5. Acoustical insulation (Sound Attenuation).
  6. Glass fiber blanket.
  7. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### **1.4 RELATED SECTIONS**

- A. Section 04 20 00 - Unit Masonry.
- B. Section 07 81 00 - Applied Fireproofing.
- C. Section 07 84 00 – Firestopping.
- D. Section 07 84 13 – Penetration Firestopping.
- E. Section 09 21 16 - Gypsum Board Assemblies.
- F. Section 09 51 00 - Acoustical Ceiling Panels.
- G. Division 23 – Mechanical: Duct Insulation.

#### **1.5 SUBMITTALS**

- A. Product Data: Technical data and installation instructions for each type of insulation product specified.
- B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect's approval.
- C. Certifications:
  1. Manufacturer's certification of compatibility of rigid insulation with dampproofing mastic.
  2. Manufacturers affidavit that materials used in Project contain no asbestos.

**(For PBK Dallas, updated 08.15.2018)**

- D. Dallas Green Building Code Submittals
  - 1. A completed Green Building Reporting Form (GBRF) with a separate line item completed for each applicable product.
  - 2. Cut Sheets: Product cut sheets for each product confirming that the submitted products are the products installed as part of the Work.
  - 3. Validation: Provide validation for each product according to the Action Submittals requirements of Section 01 8113 Sustainable Design and Construction.
    - a. Recycled Content
    - b. Indigenous Materials
    - c. Recyclable materials
    - d. Re-used materials
    - e. Bio-based materials
  - 4. Provide material mass, volume or cost for the materials included in the contractor's or subcontractor's work. Material cost does not include costs associated with labor and equipment.

**1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization.
    - a. Surface Burning Characteristic: ASTM E 84.
      - 1) Flame Spread Index: Maximum 25.
      - 2) Smoke Developed Index: Maximum 450.
    - b. Fire Resistance Ratings: ASTM E 119.
    - c. Combustion Characteristics: ASTM E 136.
  - 2. National Fire Prevention Association (NFPA) 255 Test of Surface Burning Characteristics of Building Materials.
  - 3. Underwriter's Laboratories (UL) 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Cellulose Insulation Manufacturer: Manufacturer having minimum 5 years documented experience and ISO 9002 Certified.
  - 1. Manufacturer shall provide independent laboratory follow up inspection services of Underwriters Laboratory and Factory Mutual. Label each bag accordingly.
- C. Cellulose Insulation Applicator: Applicator having minimum 5 years documented experience and licensed by manufacturer.
- D. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.
- E. Environmental Requirements: Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
  - 1. Wherever possible, provide boards from manufacturers who recycle insulation materials.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam plastic board insulation:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## 1.8 PROJECT CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence Work to ensure fireproofing and firestop materials are in place before beginning Work.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS/PRODUCTS

- A. Specifications are based on any of the manufacturers listed below, with their product in parenthesis for the particular insulation application. Other manufacturers not listed must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.

### 2.2 ROOF INSULATION SYSTEM

- A. System shall have an insulation R-value of 30 and an installed thickness of 8 inches. Roof system shall be a double layer system. A thermal block shall be applied where there is no existing thermal break. The Thermal break shall be 1 inch Snap-R™ thermal block. System components shall meet the following minimum specifications:
  - 1. Steel Strap:
    - a. 80 KSI tempered, high-tensile-strength steel, galvanized, primed and painted the specified color on the exposed side. Minimum size shall be 0.015 x 3/4 inch x continuous length.
    - b. The strap color shall be: White.
  - 2. Fasteners:
    - a. #12 x 3/4 inch plated Tek 2 screws, up to 1/4 inch thick, painted to match the specified color for light gauge steel.
    - b. #12 x 1-1/4 inch plated Tek 4 screws painted to match the specified color for heavier gauge steel, up to 3/8 inch thick.
    - c. Special fasteners for wood, concrete and other structure types as recommended by manufacturer shall be used when appropriate.
  - 3. Liner Fabric:
    - a. Shall be woven reinforced high-density polyethylene yarns coated on both sides with a continuous white polyethylene film. The fabric shall have a flame spread index of 25 or less and smoke density index of 50 or less based on ASTM E84

- test standards. This material shall be manufactured in large custom pieces by extrusion welding from roll goods. Pieces shall be fabricated to substantially fit the large defined building areas with minimum practical sealing to be done on job site. Fabric shall be folded to allow for rapid pullout on the strap support system.
- b. Liner fabric perm rating shall be: 0.025 grains/hr · sq. feet (based on ASTM E 96, procedure B, "non-inverted water method.")
  - c. Fabric grade and color shall be: Standard white.
4. Sealants: Shall be manufacturer's extruded fast-tack solvent-based vapor barrier sealant, synthetic rubber adhesive for sealing vapor barrier laps and/or pressure sensitive 3/4 inch wide by 1/32 inch thick extruded vapor barrier sealant.
  5. Insulation:
    - a. Shall be fiberglass blanket or batt insulation meeting Federal specifications HH-1-588B, Form B, Type 1 or other insulation form as may be recommended and submitted by the system manufacturer and approved by the Architect during submittals.
    - b. Insulation shall be installed in two (2) layers with the lower level being 5 inches thick and the upper level being 3 inches thick for a total R-Value of 30.
  6. Insulation Hangers: Shall be manufacturer's "FAST-R" hangers for supporting insulation between wall girts and roof purlins if roof pitch is over 4:12.
  7. Thermal Break (Block): Thermal break shall be: Manufacturer's 1 inch polystyrene "Snap-R" thermal block. The selection shall be provided as thermal break where there is no existing thermal break.
  8. Retention Netting: Galvanized poultry wire netting of size and type recommended to suit application.
- B. Approved Manufacturer: Insulation system shall be "Simple Saver System" as manufactured by Thermal Design Inc., Madison, NE; (800) 255-0776, or comparable product approved by Architect.

## **2.2 EXTRUDED POLYSTYRENE FOAM BOARD**

- A. Extruded, Polystyrene Foam Board: ASTM C578, Type IV.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Chemical Company (The).
    - b. Owens Corning.
    - c. Comparable product.

## **2.3 POLYISOCYANURATE FOAM PLASTIC BOARD**

- A. Polyisocyanurate Board, Foil Faced: ASTM C 1289, foil faced, Type I, Class 1 or 2.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Roofing Corporation.
    - b. Hunter XCI
    - c. Dupont.
    - d. Owens Corning.
    - e. Firestone Building Products.
    - f. Rmax, Inc.
  2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.



## 2.4 THERMAL INSULATION

- A. Thermal Insulation, Unfaced: ASTM C 665, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Thickness/R- Values (minimum):
    - a. 3-1/2 inches/ R-11 where shown on the Drawings.
    - b. 6 inches/ R-19 where shown on the Drawings.

## 2.5 ACOUSTICAL INSULATION (SOUND ATTENUATION)

- A. Acoustical Insulation (Sound Attenuation), Unfaced: ASTM C 612, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Thickness/R- Values (minimum):
    - a. 3-1/2 inches/ R-11 where shown on the Drawings.
    - b. 6 inches/ R-19 above lay-in ceiling specified and where shown on Drawings.

## 2.6 GLASS FIBER BLANKET

- A. Glass Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway Company.
    - c. Knauf Insulation.
    - d. Owens Corning.

## 2.7 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
  2. Spindle: Coppercoated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
  2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Crawl spaces.
    - b. Ceiling plenums.
    - c. Attic spaces.
- D. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of **[1 inch (25 mm)] [2 inches (50 mm)] [3 inches (76 mm)]** between face of insulation and substrate to which anchor is attached.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

## 2.8 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
1. Glass Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
- C. Asphalt Coating for Cellular Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.
- D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.
- B. Foam in Place Insulation: Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
1. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

### 3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.

- B. Roofing Insulation: Install insulation concurrently with installation of roof panels in accordance with manufacturer's directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.
- C. Board Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
  2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- D. Batt Insulation (Thermal and Sound): Walls: Insulation shall be friction fit between studs and provide full coverage where indicated on Drawings. Insulation shall be tight within spaces in partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.
- E. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 - "Unit Masonry."
  2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.
- F. Framed Construction: Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
  5. For metal framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
  6. For wood framed construction, install blankets according to ASTM C 1320 and as follows:
    - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
  7. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
    - a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

- G. Curtain Wall: Install board insulation in curtain wall construction according to curtain wall manufacturer's written instructions.
  - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
  - 2. Install insulation to fit snugly without bowing.
  
- H. Reflective Insulation: Install sheet reflective insulation according to ASTM C 727.
  - 1. Install sheet radiant barriers according to ASTM C 1744.
  - 2. Install interior radiation control coating system according to ASTM C 1321.

### **3.3 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 07 21 00**

## **SECTION 07 21 19 – FOAMED-IN-PLACE INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Closed cell spray polyurethane foam.
  - 2. Open cell spray polyurethane foam.
  - 3. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data and installation instructions for each type of insulation product specified.
- B. Product Test Reports: Submit test report for tests performed by a qualified testing agency based on tests performed by a qualified independent testing agency evidencing compliance of insulation products including thermal resistance, fire test response characteristics, water vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.
- C. Evaluation Reports: Submit current ICC-ES report for spray applied polyurethane foam plastic insulation.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization.
    - a. Surface Burning Characteristic: ASTM E 84.
      - 1) Flame Spread Index: Maximum 25.
      - 2) Smoke Developed Index: Maximum 450.
    - b. Fire Resistance Ratings: ASTM E 119.
    - c. Combustion Characteristics: ASTM E 136.
  - 2. National Fire Prevention Association (NFPA) 255 Test of Surface Burning Characteristics of Building Materials.
  - 3. Underwriter's Laboratories (UL) 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Applicator Qualifications: An authorized Applicator having minimum 5 years documented experience and who is trained and licensed by the manufacturer.

- D. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of work.

## **PART 2 - PRODUCTS**

- A. Closed Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1 inch (25.4 mm) thickness of 6.6 degrees F x h x sq. ft./Btu at 75 degrees F (43 K x sq. m/W at 24 degrees C).
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. CertainTeed Corporation.
    - c. Gaco Western LLC.
    - d. Huntsman Building Solutions.
    - e. Johns Manville; a Berkshire Hathaway company.
    - f. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company.
    - g. Volatile Free, Inc.
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- B. Miscellaneous Materials:
  - 1. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

### **3.2 INSTALLATION**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.
- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Cavity Walls: Install into cavities to thickness indicated on Drawings or fully fill void.
- F. Miscellaneous Voids: Apply according to manufacturer's written instructions.

**3.3 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

**END OF SECTION 07 21 19**

## **SECTION 07 24 00 - EXTERIOR INSULATION AND FINISH SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Exterior Insulation and Finish System (EIFS), consisting of a secondary weather resistive barrier, adhesive, expanded polystyrene insulation board (EPS), base coat, reinforcing mesh, and finish.

#### **1.3 REFERENCES**

- A. Exterior Insulation Manufacturers Association (EIMA)
  - 1. Guideline Specification for Exterior Insulation and Finish Systems, Class PB and Class PM.

#### **1.4 SYSTEM DESCRIPTION**

- A. Exterior Insulation and Finish System: EIMA Class PB system.

#### **1.5 SUBMITTALS**

- A. Shop Drawings: Indicate details of construction including attachments, joint patterns, penetrations, interface with flashings and adjacent materials.
- B. Quality Assurance Submittals:
  - 1. Certificates: Contractor's certification that:
    - a. Products of this Section, as provided, meet or exceed specified requirements.
    - b. Manufacturers of products of this Section meet specified qualifications.
    - c. Applicator of products of this Section meets specified qualifications.
  - 2. Manufacturer's instructions:
    - a. Printed installation instructions for each specified product.
    - b. Manufacturer's Safety Data Sheets (M.S.D.S) for each specified product.
- C. Samples: Submit two (2) samples of the EIFS System for each finish, texture and color to be used on the project. Samples shall be of sufficient size to accurately represent each color and texture being utilized on the project.
- D. Test Reports: When requested, the Contractor shall submit copies of selected test reports verifying the performance of the EIFS System.
- E. Closeout Submittals: Warranty documents, issued and executed by manufacturer of EIFS System materials.

#### **1.6 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum of five (5) years' experience.



- B. Applicator: Company knowledgeable in the proper installation of the EIFS System and experienced and competent in the installation of Exterior Insulation and Finish Systems. Additionally, the contractor shall be a current factory trained applicator.

#### **1.7 MOCKUP**

- A. Provide mock-up of system materials illustrating method of attachment located where directed by Architect.
- B. Construct mock-up 10 feet-0 inch long x 10 feet-0 inch wide, including sheathing board substrate, drainage system, insulation, surface finish, color, texture, perimeter and control joints, and typical interface with adjacent construction for Architect's approval.
- C. The approved mock-up shall be part of the finished work and will become the basis of standard for color, texture and workmanship for which all EIFS work will be judged.
- D. If mockup is not approved, remove mockup and construct new mockup until approved by Architect.

#### **1.8 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 – Project Management and Coordination.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. All materials shall be delivered to the job site in the original, unopened packages with labels intact. Questionable materials shall not be used.
- B. Minimum storage temperature shall be in accordance with manufacturer's instructions depending on product used.
- C. Protect all products from weather and direct sunlight.

#### **1.10 SEQUENCING AND SCHEDULING**

- A. Schedule Work with other construction trades to maintain integrity of exterior wall to prevent water penetration behind EIFS. Allow sufficient time for curing of EIFS materials prior to sealant application.

#### **1.11 PROJECT CONDITIONS**

- A. Application of wet materials shall not take place during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
- B. Application of wet materials shall be at a minimum ambient temperature that shall be in accordance with manufacturer's instructions depending on product. The temperatures shall be maintained for a minimum of 24 hours thereafter, or until completely dry.

#### **1.12 WARRANTY**

- A. Warrant the work specified herein for seven (7) years against defects in materials and against becoming unserviceable or causing an objectionable appearance resulting from defective or nonconforming workmanship.
- B. Defects shall include, but not be limited to the following:

1. Cracking
2. Peeling or other delaminating or releasing from substrate.
3. Noticeable deterioration or discoloring.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE PRODUCT / MANUFACTURER**

- A. Specifications are based on "Outsulation Plus" manufactured by Dryvit Systems, Inc., West Warwick RI; (800) 556-7752. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions.
1. Finestone, Jacksonville, FL; (866) 659-3133
  2. Parex, Inc. Redan, GA; (800) 537-2739
  3. Rydar, Inc., (Omega Products International, Inc.), Houston, TX; (713) 692-0400
  4. Senergy, Subsidiary of BASF Wall Systems, Inc., Jacksonville, FL; (800) 221-9255
  5. Sto Finish Systems Div., Sto Corp., Atlanta, GA; (800) 221-2397
  6. TEC, Div. H.B. Fuller, Pallatine, IL; (800) 323-7407

### **2.2 COMPONENTS**

- A. Exterior Sheathing Board: As specified in Section 09 21 16.
- B. Air/Weather Barrier: An air and secondary weather barrier for the specified sheathing substrate, including the 100 percent acrylic barrier material, tapes, flashings, and all other materials and components recommended by the EIFS system manufacturer.
- C. Adhesive: Manufacturer's recommended adhesive to adhere drainage material.
- D. Track: Manufacturer's recommended UV treated PVC "J" channels with weep holes, with and without drip edge as recommended by manufacturer or required.
- E. Drainage Strip: Manufacturer's recommended corrugated plastic strip installed to allow weepage at base of wall and at the heads of all penetrations and at expansion/control joints of EIFS system as instructed by manufacturer.
- F. Adhesives: Manufacturer's recommended type used to adhere the insulation board to the air/weather barrier. Note: Always use a vertical notched trowel adhesive pattern to adhere insulation board as instructed by manufacturer. Apply the adhesive so that the ribbons run vertically when the insulation board is placed on the wall.
- G. Base Coats: Manufacturer's recommended type used to embed the reinforcing mesh on the face of the insulation board. Backwrap all exposed edges as instructed by manufacturer.
- H. Insulation Board: Manufacturer's recommended expanded Polystyrene (EPS) insulation board.
- I. Reinforcing Meshes: Manufacturer's recommended balanced, open weave, glass fiber fabric treated for compatibility with other system materials, in sizes and weights recommended to suit intended use.
- J. Finish Coat Materials: Manufacturer's recommended finish type in color and texture selected by the Architect from manufacturer's standard water-based, acrylic coatings with integral color and texture, and formulated with DPR (Dirt Pickup Resistance) chemistry.

## **2.3 ACCESSORIES**

- A. Insulation Adhesive: Type recommended by manufacturer to suit intended use.
- B. Insulation Fasteners: Type recommended by manufacturer to suit intended use.
- C. Trim and Control Joints: Provide Galvanized steel, with attachment flanges of type recommended by manufacturer to suit intended use.
- D. Sealant Materials: Type specified in Section 07 92 00, Building Sealants.

## **2.4 PRE-COATED FOAM SHAPES**

- A. Architectural Shapes and Details: as indicated on drawings
  - 1. Mouldings
  - 2. Details, Trim, Keystones
- B. Joint Reinforcing Mesh: Self adhering glass fiber mesh (Joint Tape type) weighing a minimum of 2.8 oz/s.yd. as instructed by foam shape manufacturer.
- C. Glass fiber mesh: balanced, open weave, 3.5 oz/yd as instructed by foam shape manufacturer
- D. Rigid Insulation Core: expanded polystyrene (EPS) conforming to physical properties of ASTM C578, Type I, 1.0 lb/cu.ft. density.
- E. Adhesive: As instructed by foam shape manufacturer.
- F. Pre-coat: lightweight polymer-modified acrylic cementitious coating applied to EPS shape, in minimum thickness of 0.125 inch.
- G. Primer and Finishes: Acrylic polymer based primer and finish by manufacturer approved by foam shape manufacturer for compatibility with pre-coat cementitious coating.
- H. Fasteners: corrosion resistant, mechanical fasteners with plastic washer as instructed by foam shape manufacturer for temporary fastening of foam shapes during installation
- I. Acceptable Manufacturers:
  - 1. Decorawall Construction Systems, Inc. "Promould", locally distributed by Griesenbeck Architectural Products, Inc.; (713) 781-3287.
  - 2. Prime Stucco & Mouldings, Yonkers, NY; (800) 482-1036

## **2.5 OTHER MATERIALS**

- A. Provide other materials, not specifically described but required for a complete and proper installation.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify substrate is of correct type.
- B. Verify substrate is dry and flat within 1/4 inch in a four (4) foot radius, with tight connections, and that there are no surface voids, projections, or other conditions that may interfere with the EIFS System installation.

- C. Verify that all needed flashings and other waterproofing details have been completed, if such completion is required prior to the EIFS System application.
- D. Notify Architect of all discrepancies and do not start work until such discrepancies are corrected.
- E. Beginning Work of this Section before unacceptable conditions have been corrected is prohibited.

### **3.2 PREPARATION AND PROTECTION OF SUBSTRATE**

- A. The EIFS System materials shall be protected by permanent or temporary means from weather and other damage prior to, during, and following application until dry.
- B. Protect adjoining work and property during installation.
- C. The substrate shall be free of foreign materials such as oil, dust, dirt, form release agents, efflorescence, paint, wax, water repellants, moisture, frost, and any other condition that may inhibit adhesion.

### **3.3 INSTALLATION**

- A. Install EIFS System in accordance with the manufacturer's application instructions.
- B. The overall minimum base coat thickness shall be sufficient to fully embed the mesh in accordance with manufacturer's instructions.
- C. EIFS System surfaces in contact with sealant shall be coated in accordance with manufacturer's instructions. Sealants shall not be applied directly to textured finishes or base coat surfaces.
- D. Foam Shapes:
  - 1. Surface Preparation: The substrate shall be of a material approved by the foam shape manufacturer for compatibility with adhesive. The surface of the substrate shall be clean and free of debris, and level, plane and true, being 1/4 inch in 48 inches.
  - 2. Properly back wrap foam shapes with manufacturer approved mesh.
  - 3. Apply adhesive to the entire back surface of the using a notched trowel. Immediately, while adhesive is wet, apply by firmly pressing and properly positioning the foam shape on to the substrate base coat as instructed by manufacturer. Apply mechanical fasteners as required by manufacturer.
  - 4. Peel mesh on the back face of the shape along the entire length and fold over to extend the mesh at the bottom and top of the shape on the substrate. Apply base coat on the mesh extended from the shape onto the substrate and trowel to an acceptable smooth finish for application of finish coat.
  - 5. Mitre and butt joints shall have fiber mesh tape applied with at least 2 inches of tape applied to each side of joint. Apply cementitious base coat after mesh installation. Allow to dry and sand smooth.
  - 6. Apply sealant in accordance with manufacturer's instruction, and sealant systems at expansion joints with exposed foam shape surfaces treated with base coat and reinforcing fiber mesh.
  - 7. Apply finish coat.

### **3.4 FIELD QUALITY CONTROL**

- A. The Contractor shall be responsible for the proper application of the EIFS System materials.

**3.5 CLEANING**

- A. All excess materials shall be removed from the job site by the Contractor.
- B. All surrounding areas, where the EIFS System has been applied, shall be left free of debris and foreign substances resulting from Work of this Section.

**3.6 PROTECTION**

- A. The EIFS System shall be protected from weather and other damage until permanent protection in the form of flashings, sealants, etc. are installed.

**END OF SECTION 07 24 00**

## **SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Fluid-applied air barrier membrane in exterior wall assemblies.
- B. Materials to bridge and seal the following air leakage pathways and gaps:
  - 1. Connections of the walls to the roof air barrier.
  - 2. Connections of the walls to the foundation air barrier.
  - 3. Seismic and expansion joints.
  - 4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
  - 5. Barrier precast concrete and other envelope systems.
  - 6. Door frames.
  - 7. Piping, conduit, duct and similar penetrations.
  - 8. Masonry ties, screws, bolts and similar penetrations.
  - 9. All other air leakage pathways in the building envelope.
- C. Related Work in other Sections includes but is not limited to the following:
  - 1. Section 01 45 00 – Quality Control
  - 2. Section 01 50 00 – Temporary Facilities and Controls
  - 3. Section 03 30 00 – Cast-In-Place Concrete
  - 4. Section 04 20 00 – Unit Masonry
  - 5. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
  - 6. Section 07 65 00 – Flexible Flashing
  - 7. Section 07 90 00 – Joint Sealants
  - 8. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft<sup>2</sup> @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
- B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).
- C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft<sup>2</sup> @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.
  - 1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.

2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
  3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.
- D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:
1. Foundation and walls, including penetrations, ties and anchors.
  2. Walls, windows, curtain walls, storefronts, louvers or doors.
  3. Different wall assemblies, and fixed openings within those assemblies.
  4. Wall and roof connections.
  5. Floors over unconditioned space.
  6. Walls, floor and roof across construction, control and expansion joints.
  7. Walls, floors and roof to utility, pipe and duct penetrations.
  8. Seismic and expansion joints.
  9. All other potential air leakage pathways in the building envelope.

#### **1.4 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 – Project Coordination

#### **1.5 SUBMITTALS**

- A. Submittals: Submit in accordance with Division 1 requirements.
- B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Product Data: Submit material Manufacturer's Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.
1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer's material.
  2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
- D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.
- E. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.
- F. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

#### **1.6 QUALITY ASSURANCE**

- A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).
  - 1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.
- B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.
- C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).
- D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.
- E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer's field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.
- F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. The mock-ups shall remain visible and intact for the duration of the fluid applied air barrier system work scopes. Mock-ups shall be suitable for field testing.
- G. Mock-Up Tests for Air and Water Infiltration: The General Contractor shall provide testing of the window and door opening(s) in the mock-up for air and water infiltration. The testing shall be in accordance with AAMA 501.2 (hand wand field testing), ASTM E1186 (air leakage location), ASTM E783 (air leakage quantification) at a pressure differential of 1.57 lb/ft<sup>2</sup> (75 Pa) and ASTM E1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.
- H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.



- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.
- C. Handle materials in accordance with Manufacturer's recommendations.

## 1.8 PROJECT CONDITIONS

- A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.
- B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.
- C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.
- D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.
- E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

## 1.9 WARRANTY

- A. Material Warranty: Provide Manufacturer's standard product warranty, for a minimum 20 years from date of Substantial Completion.
- B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:
  - 1. BASF Corporation: MasterSeal AWB 660, Enershield HP, Finestop RA, Senershield R, Acrostop R and Sonowall FT R. Thickness for products are as specified by Manufacturer. [www.wallsystems.basf.com](http://www.wallsystems.basf.com):
    - a. AIR BARRIER MATERIAL PROPERTIES:
      - 1) Air permeance for this material has been tested and reported as being 0.0000 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0000 cfm/ft<sup>2</sup> @ 1.57 psf), at 10 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
      - 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m<sup>2</sup>) / 17.6

US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Fabric Reinforcement: Sheathing fabric to be saturated with BASF Fluid-Applied Membrane for use at sheathing joints, penetrations and window rough openings.
- 2) Flashing and Transition Membrane: WS Wrap polyester-faced 30-mil self-adhesive membrane or WS Membrane 20-mil self-adhesive membrane.
- 3) Water-based Primer for Self-Adhesive Membranes: WS Flashing Primer.
- 4) Mastics: As recommended by Manufacturer.

2. Carlisle Coatings and Waterproofing: Fire-Resist Barritech VP at 60 mils thick (wet). [www.carlisle-ccw.com](http://www.carlisle-ccw.com):

a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft<sup>2</sup> @ 1.57 psf), at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (817 ng/(Pa·s·m<sup>2</sup>) / 14.295 US perms) at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Detail Flashing: Fire-Resist 705 FR.
- 2) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
- 3) Water-Based Primer for Detail Flashing: CCW-702 WB.
- 4) Solvent-Based Primer for Detail Flashing: CCW-702 or CCW-702 LV.
- 5) Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP.
- 6) Reinforcing Fabric: DCH Reinforcing Fabric.
- 7) Glass Mat: LiquiFiber-W.
- 8) Termination Mastic: SURE-SEAL Lap Sealant.
- 9) Fill Compound: CCW-201 or CCW-703 V.

3. Dow Corning: DefendAir 200 at 15 mils thick (dry). [www.buildabetterbarrier.com](http://www.buildabetterbarrier.com):

a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.0010 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0010 cfm/ft<sup>2</sup> @ 1.57 psf), [0.0049 liters per square meter per second under a pressure differential of 75 Pa (0.0049 L/(s·m<sup>2</sup>) @ 75 Pa)] at 15 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 1387.7 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1387.7 ng/(Pa·s·m<sup>2</sup>) [24.26 US perms] at 15 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Solvent-Based Primer: Dow Corning® DefendAir Primer

- 2) Sealants: Dow Corning® 791 Silicone Weatherseal Sealant, Dow Corning® 756 SMS Silicone Sealant, Dow Corning® 795 Silicone Building Sealant, Dow Corning® 758 Silicone Weather Barrier Sealant
  - 3) Transition Membrane for details and terminations: Dow Corning® 778, Dow Corning® Silicone Transition Strip
  - 4) Flashing at Transition Membrane: Dow Corning® Silicone Transition Strip
  - 5) Counterflashing for Through-Wall Flashings: Dow Corning® Silicone Transition Strip
  - 6) Through-Wall Flashings or Shelf Angle Flashings: Dow Corning® 778 below the flexible through wall flashing system.
  - 7) Substrate Joint Treatment: Dow Corning® 791 Silicone Weatherseal Sealant
4. Dryvit Systems, Inc: Backstop NT at 12 mils thick (dry). [www.dryvit.com](http://www.dryvit.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.000118 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000118 cfm/ft<sup>2</sup> @ 1.57 psf), [0.0006 liters per square meter per second under a pressure differential of 75 Pa (0.0006 L/(s·m<sup>2</sup>) @ 75 Pa)] at 12 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 1810 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1810 ng/(Pa·s·m<sup>2</sup>) [31.65 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Transition Membrane for details and terminations: Dryvit AquaFlash and AquaFlash Mesh
    - 2) Reinforcing / Joint Tape: Dryvit Grid Tape
    - 3) Flashing at Transition Membrane: Dryvit AquaFlash
    - 4) Substrate Joint Treatment: Dryvit Grid Tape with Backstop NT
5. DuPont Building Innovations: Tyvek Fluid Applied WB at 25 mils thick (wet), 25 mils thick (dry). [www.Weatherization.Tyvek.com](http://www.Weatherization.Tyvek.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft<sup>2</sup> @ 1.57 psf), at 25 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 1384 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1384 ng/(Pa·s·m<sup>2</sup>) / 24.23 US perms) at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Solvent Based Primer for Flashing, Transition Strip and Detail Membranes: 3M High Strength 90; Denso Butyl (used with self-adhered membranes only).
    - 2) Through-Wall Flashings or Shelf Angle Flashings: DuPont recommended through-wall flashing.

- 3) Sealants, Mastics, Adhesives and Tapes: DuPont Sealant for Tyvek Fluid Applied System; DuPont Tyvek Flashing and Joint Compound; fiberglass mesh tape.
  - 4) Transition, Termination, and Detailing Membrane: DuPont StraightFlash, or DuPont Tyvek Flashing and Joint Compound (60mil).
  - 5) Penetrations and Termination Sealant: DuPont Sealant for Tyvek Fluid Applied System.
  - 6) Window Flashing Membrane: DuPont Tyvek Fluid Applied Flashing and Joint Compound, or DuPont Tyvek Fluid Applied Flashing – Brush Formulation, or DuPont StraightFlash with DuPont FlexWrap.
  - 7) Joint Treatment: None ( $\leq 1/16$ " gaps); DuPont Tyvek Flashing and Joint Compound ( $\leq 1/4$ " gaps); DuPont Tyvek Flashing and Joint Compound w/ fiberglass mesh tape ( $\leq 1/2$ " gaps); DuPont StraightFlash ( $\leq 1$ " gaps).
6. Grace Construction Products: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry). [www.na.graceconstruction.com](http://www.na.graceconstruction.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot ( $0.0004 \text{ cfm/ft}^2 @ 1.57 \text{ psf}$ ), at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ( $741.6 \text{ ng}/(\text{Pa} \cdot \text{s} \cdot \text{m}^2) / 12.9 \text{ US perms}$ ) at 40 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Membrane for details and Terminations: Bituthene Liquid Membrane.
    - 2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
    - 3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC or Bituthene Primer B2.
    - 4) Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing below the flexible through wall flashing system.
    - 5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
    - 6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
    - 7) Penetrations and Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
    - 8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
    - 9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.
7. Henry Company: Air Bloc 17MR at 48 mils (wet) - \*Medium build option\*. [www.henry.com](http://www.henry.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds

- per square foot (0.0001 cfm/ft<sup>2</sup> @ 1.57 psf), at 48 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 28 US perms at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Liquid Applied Flashing: Air-Bloc LF.
  - 2) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
  - 3) Sheathing Joint Membrane: Blueskin VP160.
  - 4) Spray Adhesive: Blueskin Adhesive and Blueskin LVC Adhesive.
  - 5) Water-Based Primer for Transition Membrane: Aquatac Primer.
  - 6) Counterflashing for Metal Panel Through-Wall Flashing: Blueskin TWF.
  - 7) Sealant: HE 925 BES Sealant.
  - 8) Reinforcing Tape: HE 183 Yellow Glass Fabric.
  - 9) Insulation Adhesive: Air-Bloc 21.
8. Momentive Performance Materials, Inc.: GE Elemax 2600 at 17 mils (dry).  
[www.ge.com/silicones](http://www.ge.com/silicones):
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0006 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0006 cfm/ft<sup>2</sup> @ 1.57 psf), at 17 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
  - 2) Water vapor permeance for this material has been tested and reported as being 581 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (581 ng/(Pa·s·m<sup>2</sup>) / 10.16 US perms) at 17 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Solvent-Based Primer: SS80.
  - 2) Sealants: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
  - 3) Transition Membrane for details and terminations: Elemax 5000 Liquid Flashing; UltraSpan UST2200; UltraSpan USM pre-formed silicone molded corners parts.
  - 4) Substrate Joint Treatment: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
  - 5) Reinforcing Fabric: RF100.
9. Pecora USA: Pecora XL-Perm ULTRA VP by Pecora USA at 9 – 12 mils (dry).  
[www.pecora.com](http://www.pecora.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft<sup>2</sup> @ 1.57 psf), 0.0012 liters per square meter per second under a pressure differential of 75 Pa (0.0012 L/(s·m<sup>2</sup>) @ 75 Pa) at 12 mils (dry) when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 727.01 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (727.01 ng/(Pa·s·m<sup>2</sup>) (12.71 US perms) at 9 mils - dry when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Sealants: 890NST Silicone Sealant, AVB Silicone Sealant
  - 2) Transition Membrane for details and terminations: XL Span
  - 3) Flashing at Transition Membranes: XL Flash Liquid Flashing & Joint Filler
  - 4) Counter-Flashing for Through-Wall Flashings: XL Flash Liquid Flashing & Joint Filler with Flexible Flashing.
  - 5) Through-Wall Flashings or Shelf Angle Flashings: XL Flash Liquid Flashing & Joint Filler below the flexible through wall flashing system.
  - 6) Substrate Joint Treatment: XL Flash Liquid Flashing & Joint Filler, 890 NST Silicone Sealant, AC-20 Latex Sealant, AVW-920 Latex Sealant, Dynatrol I-XL-345 Tru White STPU Sealant
10. PROSOCO, Inc.: Spray Wrap MVP at 10 mils (wet). [www.prosoco.com](http://www.prosoco.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00086 cfm/ft<sup>2</sup> @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
  - 2) Water vapor permeance for this material has been tested and reported as being 1430 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1430 ng/(Pa·s·m<sup>2</sup>) / 25 US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water-Based Primer: PROSOCO R-GUARD PorousPrep for cut gyp board edged in rough openings.
  - 2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
  - 3) Transition Membrane for details and terminations: PROSOCO R-GUARD SureSpan EX
  - 4) Flashing at Transition Membrane: PROSOCO R-GUARD FastFlash
  - 5) Counter-flashing for Through-Wall Flashings: Combination of PROSOCO R-GUARD Joint & Seam Filler and PROSOCO R-GUARD FastFlash or FastFlash alone as a fill and flashing product.
  - 6) Through-Wall Flashings or Shelf Angle Flashings: Combination of PROSOCO R-GUARD Joint & Seam Filler and PROSOCO R-GUARD FastFlash or FastFlash alone as a fill product and flashing below the flexible through wall flashing system.
  - 7) Substrate Joint Treatment: PROSOCO R-GUARD FastFlash and / or PROSOCO R-GUARD Joint & Seam Filler.
  - 8) Rough Openings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
11. PROSOCO, Inc.: Cat 5 at 12 - 15 mils (wet). [www.prosoco.com](http://www.prosoco.com):

- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.00018 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00018 cfm/ft<sup>2</sup> @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 1015 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1015 ng/(Pa·s·m<sup>2</sup>) / 17.71 US perms) at 12 – 15 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Water-Based Primer: PROSOCO R-GUARD GypPrime for cut gyp board edged in rough openings.
    - 2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
    - 3) Counter-flashing for Through-Wall Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
    - 4) Through-Wall Flashings or Shelf Angle Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash below the flexible through wall flashing system.
    - 5) Substrate Joint Treatment: PROSOCO R-GUARD Joint & Seam Filler for sheathing seams, PROSOCO R-GUARD Joint & Seam Filler covered by PROSOCO R-GUARD FastFlash in rough opening.
12. Protecto Wrap: Protecto Wall Liquid Air Barrier VP by at 10 mils (dry). [www.protectowrap.com](http://www.protectowrap.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000864 cfm/ft<sup>2</sup> @ 1.57 psf), 0.0043 liters per square meter per second under a pressure differential of 75 Pa (0.0043 L/(s·m<sup>2</sup>) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 660.8 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (660.8 ng/(Pa·s·m<sup>2</sup>) [11.5 US perms] at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Water-Based Primer: Universal Water Based Primer.
    - 2) Solvent-Based Primer: BT Primer.
    - 3) Solvent-Based Aerosol Primer: Protecto-Tak Spray Adhesive.
    - 4) Sealants: Protecto Wall Board to Board Joint Sealant.
    - 5) Transition Membrane for details and terminations: Protecto Wall Transition Tape.
    - 6) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BT Primer.
    - 7) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Universal Water Based Primer.

- 8) Substrate Joint Treatment: Protecto Wall Board to Board Joint Sealant.
13. Sika Corporation: Sikagard 530 Liquid Applied Vapor Permeable Air Barrier at 30 mils (dry). [www.sika.com](http://www.sika.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being < 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.0001 cfm/ft<sup>2</sup> @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
  - 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m<sup>2</sup>) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water-Based Primer: Sikagard 530.
  - 2) Solvent-Based Primer: Sikagard 510.
  - 3) Termination Mastic: Sikaflex 11FC.
  - 4) Sealants: Sikaflex 11FC.
  - 5) Transition Membrane for details and terminations: SikaMultiSeal 515.
  - 6) Reinforcing/Joint Tape: SikaMultiSeal 515.
  - 7) Counterflashing for Through-Wall Flashings: SikaMultiSeal Plus with Flexible Flashing.
  - 8) Through-Wall Flashings or Shelf Angle Flashings: SikaMultiSeal Plus below the flexible through wall flashing system.
  - 9) Substrate Joint Treatment: Sikaflex 11FC.
14. Soproma: Sopraseal LM 202 VP at 10 mils (wet) [www.soprema.us](http://www.soprema.us)
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.00004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00004 cfm/ft<sup>2</sup> @ 1.57 psf), [0.0002 liters per square meter per second under a pressure differential of 75 Pa (0.0002 L/(s·m<sup>2</sup>) @ 75 Pa)] at 10 mils (wet) when tested in accordance with ASTM E 2178 (unmodified).
  - 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m<sup>2</sup>) [17.6 US perms] at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water Based Primer: Soprema Elastocol Stick H20 Primer
  - 2) Solvent-Based Primer: Soprema Sopraseal Stick primer
  - 3) Sealants: Soprema Sopraseal sealant
  - 4) Transition Membrane for details and terminations: Soprema Sopraseal Stick 1100T or Soprema Soprsolin HD
  - 5) Substrate Joint Treatment: Soprema Sopraseal Mesh
15. Sto Corp: Emerald Coat at 20 mils (dry). [www.stocorp.com](http://www.stocorp.com):



- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.000024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft<sup>2</sup> @ 1.57 psf), [0.00020 liters per square meter per second under a pressure differential of 75 Pa (0.00020 L/(s·m<sup>2</sup>) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 797.94 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (797.94 ng/(Pa·s·m<sup>2</sup>) [13.95 US perms] at 12 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Joint and Rough Opening Treatments: Sto Gold Fill with StoGuard Mesh, StoGuard Rapid Seal with StoGuard Mesh, Sto EmeraldCoat with SToGuard Fabric, StoGuard Tape
    - 2) Joint Reinforcements: StoGuard Mesh, StoGuard Fabric, StoGuard RediCorner
    - 3) Transition Membranes: Sto Gold Fill with StoGuard Mesh, StoGuard RapidSeal or StoGuard RapidSeal with StoGuard Mesh, Sto Emerald Cost with StoGuard Fabric, StoGuard Tape
    - 4) Water-Based Primer for use with Flashing Transition: StoGuard
16. STS Coatings: Wall Guardian FW-100-A (Acrylic-based component) 40 mils (wet), 20 mils (dry). [www.wallguardian.com](http://www.wallguardian.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft<sup>2</sup> @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m<sup>2</sup>) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: None.
    - 2) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BP-40 Primer for use with UT-40 Universal Tape.
    - 3) Through-Wall Flashings or Shelf Angle Flashings: Gorilla Flash VF-1000.
    - 4) Mastics: None.
    - 5) Adhesives and Tapes: Universal Tape UT-40, a butyl based tape and Great Seal LT-100, a low voc elastomeric sealant for deflection joints and details.
    - 6) Transition Strip: Universal Tape, UT-40.
    - 7) Termination Mastic: Great Seal LT-100.
    - 8) Window Flashing and Detail Membrane: Universal Tape UT-40.
17. TK Products: TK-AirMax 2103 at 40+ mils (wet). [www.tkproducts.com](http://www.tkproducts.com):
- a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.00097 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00097 cfm/ft<sup>2</sup> @ 1.57 psf), 0.00492 liters per square meter per second under a pressure differential of 75 Pa (0.00492 L/(s·m<sup>2</sup>) @ 75 Pa)] at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
  - 2) Water vapor permeance for this material has been tested and reported as being 857 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (857 ng/(Pa·s·m<sup>2</sup>) [15.0 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18 below the flexible through wall flashing system.
  - 2) Caulk: TK-Super Seal
  - 3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheathing Facing Tape (Venture Tape, a 3M Company)
  - 4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
  - 5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
  - 6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
  - 7) Flashing (Counter) for at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
18. TK Products: TK-AirMax 2104 at 40+ mils (wet). [www.tkproducts.com](http://www.tkproducts.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0008 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0008 cfm/ft<sup>2</sup> @ 1.57 psf), at 40+ mils (wet) when tested in accordance with ASTM E2178 (unmodified).
  - 2) Water vapor permeance for this material has been tested and reported as being 1007 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1007 ng/(Pa·s·m<sup>2</sup>) / 17.6 US perms) at 14 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18 below the flexible through wall flashing system.
  - 2) Caulk: TK-Super Seal.
  - 3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company),

- VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheeting Facing Tape (Venture Tape, a 3M Company).
- 4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
  - 5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
  - 6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
  - 7) Flashing (Counter) for at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
19. Tremco, Inc.: ExoAir 230 at 40 mils (wet) [www.tremcosealants.com](http://www.tremcosealants.com)
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.0003 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0003 cfm/ft<sup>2</sup> @ 1.57 psf), at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 1677 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1677 ng/(Pa·s·m<sup>2</sup>) at 29 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).
  - b. AIR BARRIER ACCESSORY MATERIALS:
    - 1) Solvent Based Primer: ExoAir Primer
    - 2) Termination Mastic: ExoAir Termination Mastic
    - 3) Sealants: Tremflex 834, Dymonic 100, Spectrem 1
    - 4) Transition Membrane for Details and Terminations: ExoAir 110, ExoAir 111, ExoAir TWF, Dymonic 100
    - 5) Reinforcing / Joint Tape: Tremco 2011 mesh
    - 6) Flashing at Transition Membrane: ExoAir 111, ExoAir TWF, Dymonic 100
    - 7) Counterflashing for Through Wall Flashings: ExoAir TWF
    - 8) Through Wall Flashings or Shelf Angle Flashings: ExoAir TWF below the flexible through wall flashing system.
    - 9) Solvent Based Primer for Flashing, Transition Strip and Detail Membrane: ExoAir Primer
    - 10) Substrate Joint Treatment: Tremflex 834, Dymonic 100 depending on substrate.
20. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry). [www.wrmeadows.com](http://www.wrmeadows.com):
- a. AIR BARRIER MATERIAL PROPERTIES:
    - 1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft<sup>2</sup> @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m<sup>2</sup>) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
    - 2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m<sup>2</sup>) [10.47 US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Water-Based Primer: None required for Air Shield LMP.
- 2) Solvent-Based Primer: None required for Air Shield LMP.
- 3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
- 4) Termination Mastic: Pointing Mastic or BEM.
- 5) Transition Membrane for details and terminations: Air Shield.
- 6) Reinforcing / Joint Tape: Reinforcing Fabric HCR.
- 7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
- 8) Counter-flashing for Through-Wall Flashings: Air Shield Thru-Wall Flashing.
- 9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing below the flexible through wall flashing system.
- 10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
- 11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
- 12) Substrate Joint Treatment: Air Shield Joint Filler.

**2.2 AUXILIARY MATERIALS**

- A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.
- B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.
  1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
  2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
  3. Ensure that the following conditions are met:
    - a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
    - b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
    - c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.
    - d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
  4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.

5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
  1. Ensure that penetrating work by other trades is in place and complete.
  2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
  3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.
- B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:
  1. Prime masonry, concrete substrates with conditioning primers.
  2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
  3. Prime wood, metal, and painted substrates with primer.
  4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.
- C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.
- D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:
  1. Mask and cover adjacent areas to protect from over-spray.
  2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

### **3.3 INSTALLATION**

- A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions and the following (unless Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):
  1. Install veneer anchors as per air barrier Manufacturer installation sequencing.
  2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
  3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
  4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.

5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.
7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer's instructions.
8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
10. Lap transition material over top edge of through-wall flashing and head-flashing.
11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
12. Provide transition material to joint assemblies at expansion and seismic joints.
13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.
14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.
16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
19. Do not allow materials to come in contact with chemically incompatible materials.
20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.
21. Turn flashing membrane into window opening at sill, jambs and heads. Terminate just before interior sealant bead.

### **3.4 FIELD QUALITY CONTROL**

- A. Owner's Inspection and Testing: Cooperate with Owner's testing agency as applicable. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
- B. Manufacturer's Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer's Field Representative on site. The Manufacturer's Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

**3.5 PROTECTING AND CLEANING**

- A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.
  - 1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

**END OF SECTION**

## **SECTION 07 52 19 - MODIFIED BITUMEN "COOL ROOF" MEMBRANE ROOFING SYSTEM**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. The installer shall coordinate the work of the entire roofing assembly, including, but not limited to:
  - 1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
  - 2. Curbs, (Refer to Section 07 72 00)
  - 3. Modified bitumen membrane roofing
  - 4. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00)
  - 5. Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
- B. It is the intent of this Section that the Work shall:
  - 1. provide a watertight facility;
  - 2. conform to all applicable building code requirements and of authorities having jurisdiction;
  - 3. include Section 07 62 00, Sheet Metal Flashing, Downspouts, Gutters and Trim, and Section 07 72 00, Roof Accessories as part of the Work of this Section; and
  - 4. Provide Owner with a single source full system warranty as specified.

#### **1.3 RELATED WORK**

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

#### **1.4 REFERENCES**

- A. ASTM International (ASTM)
  - 1. C728, Standard Specification for Perlite Thermal Insulation Board
  - 2. C920, Standard Specification for Elastomeric Joint Sealants
  - 3. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
  - 4. D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
  - 5. D312, Standard Specification for Asphalt Used in Roofing
  - 6. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
  - 7. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
  - 8. D4897, Standard Specification for Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
  - 9. D5147, Standard Specification for Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
  - 10. D6163, (D5147 & D146) Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements



- B. ASCE-7 Wind uplifts requirements for geographical area.
- C. Federal Specifications (FS)
  - 1. TT-S-00230C
- D. National Roofing Installers Association (NRCA)
  - 1. Roofing and Waterproofing Manual - Latest Edition
- F. Sheet Metal and Air Conditioning Installers National Association, Inc. (SMACNA)
  - 1. Architectural Sheet Metal Manual - Latest Edition
- G. Underwriters' Laboratories (UL)
  - 1. Fire Hazard Classifications
- H. International Building Code

### 1.5 SUBMITTALS

- A. Product Data: Manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.
- B. Certifications:
  - 1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system. **(Submit a copy with Proposal Form).**
  - 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
  - 3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
  - 4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subinstaller on this project and that all workers on this project are covered by workmen's compensation.
  - 5. Installer shall submit list of all subinstallers with evidence of subinstaller's insurance coverage in compliance with contract requirements.
  - 6. Manufacturer's written certification of approval / acceptance of these specifications and details.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Project Registration "Pin" proving the project has been registered with Manufacturer.
- E. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", Latest Edition.
  - 1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
  - 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.
- F. Samples:
  - 1. Furnish copy of sample warranty that is to be issued upon project completion.
- G. Temperature Charts: Bitumen heating devices 24 hour temperature charts.

- H. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
  - 1. Softening Point: ASTM D312.
  - 2. Flashpoint: ASTM D92.
  - 3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
  - 4. Thermometers: Two (2) hand held, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.
- I. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
  - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
  - 2. Maintenance Procedures: Three (3) copies of Manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.
- J. Certificate of Analysis: Provide manufacturer's printed certificate of analysis for all materials used. Attach copy with final warranty.

## 1.6 INSPECTIONS / TESTS

- A. The Owner's, Architect's, and Manufacturer's representative shall at all times have access to the job site and work areas. The installer will provide proper and safe facilities for such access and inspection.
  - 1. Architect Inspections:
    - a. The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
  - 2. Manufacturer Inspections:
    - a. An inspection shall be made by a representative of the material manufacturer at appropriate intervals during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
    - b. The authorized material Manufacturer's field representative shall be responsible for:
      - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
      - 2) Calling to the attention of the installer those matters observed which are considered to be in violation of the contract requirements.
      - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the installer to correct unacceptable practices called to his attention.
      - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications. Final payment will not be released until the Architect has received all specified warranties.
- B. Any failure by the Owner's, Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the installer, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.

- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
  - 1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
  - 2. Retests for work which fail initial tests or inspections shall be paid by installer.

## 1.7 QUALITY ASSURANCE

### A. Installer:

- 1. Installer shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
- 2. Installer shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
- 3. Installer shall be certified and approved by manufacturer and licensed to install specified roofing system.
- 4. No subcontracting of sheet metal fabrication or installation will be accepted. Installer must have a sheet metal shop on the company premises.
- 5. Installers shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Installer as his agent.
- 6. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
- 7. Installer shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
- 8. Roofing installer must have reached the highest level of qualifications from the Manufacturer they are providing material for (i.e. Master Select installer).

### B. Regulatory Requirements:

- 1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
- 2. Roofing system shall be installed in accordance with ASCE-7-16 wind uplift requirements for geographical location exposure B, 150 MPH 3-second gust wind speed zone and risk category III based on IBC building code requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
  - a. Zone 1 Field 73.6 psf or as otherwise indicated by Structural
  - b. Zone 2 Perimeter 123.4 psf or as otherwise indicated by Structural
  - c. Zone 3 Corner 185.8 psf or as otherwise indicated by Structural
- 3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

### C. Laboratory Testing and Samples:

- 1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
- 2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Installer shall assume all costs for extraction and patch of all samples.
- 3. Re-tests for work which fail initial tests or installer shall pay inspections.

4. Installer shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.

D. Installation:

1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Installer's Association.
3. It will be the installer's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the installer shall be responsible for the correctness of it. Any drawings supplied are for reference only.
4. Installer shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all installers' equipment and materials removed from the site.

**1.8 PERFORMANCE REQUIREMENTS**

- A. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.
- B. Installer shall ensure that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

**1.9 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 – Project Coordination.

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. The proper storage of materials is the sole responsibility of the installer. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All stored materials, as mentioned above, shall be minimum of four (4) inches off the substrate and the tarpaulin tied off with rope.
- C. Products liable to degrade as a result of being frozen shall be maintained above 40° F in heated storage.

- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

### **1.11 WARRANTY / GUARANTEE**

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
  - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
  - 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
  - 3. The roof system including roofing insulation, flashing, penetrations, wall flashings, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
  - 4. Submit four (4) original executed copies of the Warranty / Guarantee.
- B. Roofing Installer: Jointly with any subinstallers employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Installer, and subinstallers, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.
- C. Make arrangements with the materials manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.
- D. Submit attached Installer's Warranty and Subinstaller's Guarantee forms at Project Closeout.

## **PART 2 - PRODUCTS**

### **2.1 APPROVED PRODUCTS/MANUFACTURERS**

- A. Unless noted otherwise, specifications are based on products of named manufacturers but should not preclude the Installer from using other manufacturers who produce products that meet or exceed the specifications. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
  - 1. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an installer licensed by the manufacturer.

2. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
3. All materials used on the project shall be asbestos free.

B. Approved Manufactures:

1. Siplast, Inc., Irving, Texas; (972) 869-0070
2. Soprema, Wadsworth, OH; (800) 356-3521
3. Firestone Building Products Company, Carmel, IN; (800) 428-4442
4. Johns Manville, Denver, CO; (800) 654-3103

## 2.2 ROOFING SYSTEM ASSEMBLY/PRODUCTS

A. Modified Base Sheet: A fiberglass reinforced, Styrene-Butadiene-Styrene (SBS) modified asphalt coated sheet, having an average weight of 28 pounds per square.

1. Approved Product:
  - a. Siplast Product: Para Base, base sheet
  - b. Soprema Product: Sopra-G, base sheet
  - c. JM Product: Perma Ply 28, base sheet
  - d. Firestone Product: MB Base, base sheet

B. Dry Sheathing Paper: (For use as a slip sheet) Rosin coated, 5 lbs. per 100 sq. ft.

## 2.3 ROOF MEMBRANE ASSEMBLY

A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Installer option to install using hot asphalt "mopped", cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.

1. **Hot Asphalt Applied Modified Bitumen Base Ply:** Approximately 90 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
  - a. Approved Product:
    - 1) Siplast Product: Paradiene 20
    - 2) Soprema Product: Elastophene Sanded 2.2
    - 3) Firestone Product: SBS Base
    - 4) JM Product: DynaBase
2. **Torch Applied Modified Bitumen Base Ply:** Approximately 120 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
  - a. Approved Product:
    - 1) Siplast Product: Paradiene 20 TG
    - 2) Soprema Product: Elastophene Flam
    - 3) Firestone Product: SBS Glass Torch Base
    - 4) JM Product: DynaWeld Base

3. **Hot Asphalt Applied Modified Bitumen Finish Ply:** Approximately 130 mil or better high performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
  - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
  - b. Surfacing: White ceramic chips
  - c. Solar Reflectance (avg.): greater than 3 year aged .75
  - d. Thermal Emittance (avg.): greater than 3 year aged .75
  - e. Solar Reflectance Index (avg.): greater than 3 year aged 64
  - f. Approved Product:
    - 1) Siplast Product: Paradiene 30 FR BW
    - 2) Soprema Product: Elastophene LS FR GR SG
    - 3) Firestone Product: SBS Glass FR Ultrawhite
    - 4) JM Product: DynaGlas FR CR G
  
4. **Torch Applied Modified Bitumen Finish Ply:** Approximately 140 mil or better high performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
  - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
  - b. Surfacing: White ceramic chips
  - c. Solar Reflectance (avg.): greater than 3 year aged .75
  - d. Thermal Emittance (avg.): greater than 3 year aged .75
  - e. Solar Reflectance Index (avg.): greater than 3 year aged 64
  - f. Approved Product:
    - 1) Siplast Product: Paradiene 30 FR TG BW
    - 2) Soprema Product: Elastophene Flam LS FR GR SG
    - 3) Firestone Product: SBS Glass FR Torch Ultrawhite
    - 4) JM Product: Dynaweld Cap FR CR
  
5. Stripping Ply: Same as roof system base ply.

## 2.4 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified asphalt membrane (foil face flashing membrane can be used as substitute):
  1. Modified Bitumen Flashing Sheet: Same as roof system finish ply.
  
  2. Modified Bitumen Foil Faced Flashing Sheet (Substitute):
    - a. Siplast Product: “Aluminum” Veral
    - b. Soprema Product: Sopralast 50 TV “Alu”
    - c. Firestone Product: SBS Metal Flash AL
    - d. JM Product: DynaClad AL
  
  3. Reinforcing Ply: Same as roof system base ply.

## 2.5 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

## 2.6 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

## 2.7 ROOF INSULATION

- A. Roofing Insulation:
  - 1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval. Refer to Div. 3 for insulation in lightweight concrete.

## 2.8 ROOFING ACCESSORIES

- A. Roofing Adhesives:
  - 1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
    - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
  - 2. Cold Adhesive (if applicable): An asphalt based adhesive formulated especially for adhering polymer modified asphalt roofing membranes and base plies. Adhere shall be UL & FM listed and approved.
    - a. Soprema Product: FMA
    - b. Siplast Product: PA-311 Adhesive
    - c. Firestone Product: MB Cold Adhesive
    - d. JM Product: MBR Cold Application Adhesive
- B. Bituminous Cutback Materials:
  - 1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
    - a. Approved Product: PA-1125 Asphalt Primer manufactured by Siplast.
  - 2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
    - a. Approved Product: PA-1021 Plastic Cement manufactured by Siplast.
- C. Caulking and Sealants:
  - 1. VOC Content: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Nonmembrane Roof Sealants: 300 g/L; single component, high performance, elastomeric sealants conforming to ASTM C920 requirements.
    - b. Modified Bituminous Sealants: 500 g/L
    - c. Other sealants: 420 g/L
- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.



- E. Metallic Dust: A finely graded metal dust as supplied or approved by the membrane manufacturer, used for covering of bitumen overruns over the foil surfaced membrane.
- F. Fasteners:
1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
  2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
  3. Fastener for Wood: Shall be a #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal.
  4. Lightweight Insulating Concrete Base Sheet Fasteners: Shall be approved by the fastener manufacturer, membrane manufacturer and FM for use with lightweight insulating concrete as follows:
    - a. Fastener shall be a single unit, precision formed, of electro zinc coated steel having a 2.7 inch diameter rib reinforced cap and 1.7 inch long rectangular legs, designed to expand when fully driven into the lightweight insulating concrete. Fasteners for lightweight insulating concrete shall meet FM Standard 4470 requirements for corrosion resistance.
      - 1) Approved Product: "Zono-tite" Base Sheet Fasteners.
  5. Roofing Nails: Stainless steel, 316, type, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head, minimum 1-1/2 inches in length.
  6. Dual Prong Fastener: Coated Steel tube with stainless steel Locking Staple.
- G. Walkway Pads: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface meeting the following physical and mechanical requirements:
1. Thickness: 0.217 inch
  2. Weight: 1.8 lb./ft<sup>2</sup>
  3. Width: 30 inches
  4. Approved Product: Paratread Roof Protection Material
- H. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three part system at all penetrations.

## 2.9 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.
1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
  2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations and included in system warranty.
    - a. Approved Substitute Soprema's "Sopra Joint". Install as per manufacturer's recommendations.

3. Sealant Backer Rod: Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07 72 00, Roof Accessories.
5. Relief vents, lead and other sheet metal materials shall be as specified in Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.
6. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.

### **PART 3 - EXECUTION**

#### **3.1 SITE CONDITIONS**

- A. Environmental Requirements:
  1. Apply roofing in dry weather.
  2. Do not apply roofing when ambient temperature is below 45 degrees F.
  3. Refer to manufacturers recommendations.
- B. Field Tests:
  1. Deck Dryness Test: Test for dryness before applying roofing. Should rain occur during application, retest for dryness before continuing application.
  2. Foaming: Heat one Pt. of specified bitumen to 350 degrees F; pour on surface to receive roofing felts. If bitumen foams, deck is dry enough to roof.
  3. Stripability: Cool bitumen poured on deck to ambient temperature and strip from surface. If any portion strips clean from deck, surface is not dry enough to roof.

#### **3.2 ROOFING AND FLASHING - GENERAL**

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. General Installation:
  1. Protect adjacent areas with tarpaulin or other durable materials.
  2. Installer shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
  3. Prepare surfaces according to manufacturer's or installer's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive,

shall be first primed with appropriate primer. Use cleaning materials or primers necessary to render a clean and dry surface/substrate.

4. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
5. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
6. Wrinkles, buckles, kinks, fishmouths, and dry voids of felt on felt are not acceptable when laying felt and membrane.
7. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
8. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge, and be a minimum of eight (8) inches in height from finished membrane.
9. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
10. Correct all errors in application the same work day they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage and all work not meeting specifications.

### 3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.
- B. All Construction: Nailers shall be the same height as the new lightweight insulating concrete deck or insulation being installed. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer and be spaced at two (2) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of ten (10) inches above the deck.
- C. Provide additional nailer at all curbs to provide positive drainage away from curb.

### 3.4 SUBSTRATE PREPARATION

- A. Lightweight Insulating Concrete Deck Systems: Nailable fills shall receive base sheet properly fastened with suitable FM approved fasteners and installed in accordance with ASCE 7 wind uplift pressure calculations.
  1. Damaged lightweight fill decks shall be removed back to solid material. Fill holes, bird baths, etc., in deck using Zonopatch as manufactured by Siplast; or equal by approved manufacturer.

### 3.5 APPLICATION OF BASE SHEET

- A. Lightweight concrete deck shall be covered with a base sheet, mechanically fastened as follows:
  1. Install in accordance with manufacturer's current published application instructions and to meet ASCE-7 wind uplift requirements. Fasteners and fastening patterns shall be determined by building height, pull out values from lightweight insulating concrete decks (more stringent applies), location and geographical area of the United States. It is the installer's responsibility to consult current ASCE-7 publications, literature, and bulletins that are in effect at the time of this project.

Submit perimeter, field and corner fastening patterns and cite all ASCE-7 data pertaining to the fastening pattern to the Architect for review.

### 3.6 ROOF ASSEMBLY INSTALLATION

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- D. Roofing Application:
  - 1. Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
    - a. Apply all layers of roofing perpendicular to the slope of the deck so that water flows over or along lap seams, but never against laps.
    - b. Fully bond the base ply to the base sheet or recover board with cold adhesive, torch, hot asphalt or mechanically attached-(Installer's option). Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive installer. Stagger end laps a minimum of three (3) feet.
    - c. Fully bond the finish ply to the base ply (Installer's option). Each sheet shall have a minimum of three (3) inch side and end laps. Each sheet shall be applied directly behind the asphalt installer. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
    - d. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes. Cold process adhesives shall be used on slopes over 1/2 inch per foot up to and including six (6) inches per foot.
    - e. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out. Strictly follow manufacturers guidelines on bleedout.
- E. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color.

### 3.7 ROOF ASSEMBLY FLASHING INSTALLATION

- A. Flashing - General:

1. Flashings shall be installed using the manufacturer's Veral flashing membrane, with length of run not to exceed manufacturer's recommendations.
  2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade treated timber, and of the same thickness as any insulation to be used on the roof.
  3. Cant strips shall be installed at the intersection of the deck and / or all vertical surfaces. Prime all cants.
  4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
  5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
  6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height, extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
  7. Install flashing membrane in accordance with drawings and / or material manufacturer's guarantee requirements, whichever is the most stringent.
- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall / roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See Manufacturer's schematic for visual interpretation.)
- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall / roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)
- D. Projection Flashings:

1. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three part system at all penetrations.
- E. Wall and Curb Flashings:
1. The flashing substrate shall be free of all dirt and loose material.
  2.  $\frac{3}{4}$ " plywood is to be used at all parapets that receive wall flashings.
  3. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
  4. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
  5. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
  6. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
  7. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
  8. Cricket the up-side slope at all curb projections.
- F. Use of Metallic Powder: Broadcast metallic powder over all bitumen overruns on the metal foil membrane surface while the bitumen is still hot to ensure a monolithic surface color.
- G. Overnight Seal / Water Cut-Off:
1. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
  2. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

### 3.8 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.
- B. Walkway Pads:
1. Provide around all roof hatches, A/C units (if applicable) and at top and bottom of all roof access ladders.
  2. Cut the material into maximum five (5) foot lengths and allow to relax until flat.
  3. Adhere the sheet using the specified plastic cement. Apply the specified cement in a  $\frac{3}{8}$  inch thickness to the back of the product in five (5) inch by five (5) inch spots in accordance with the pattern as supplied by the material Manufacturer.
  4. Install the walkway pad. Use a minimum spacing of two (2) inches between sheets to allow for proper drainage.
  5. Walk-in each sheet after application to ensure proper adhesion.

- C. Sealant: Seal all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of Manufacturer's approved sealant.
- D. Piping / Conduit: Provide hangers and supports as specified in Section 07 72 00, Roof Accessories. Coordinate locations with Architect.
- E. Sheet Metal: Refer to Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

### **3.9 FIELD QUALITY CONTROL AND INSPECTIONS**

- A. Roof cuts shall be performed and repaired at installer's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane Manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.
- B. Remove not more than one (1) 12 inch by 12 inch cut per 5,000 square feet of roof area or fraction thereof.
- C. Field audit will follow criteria outlined in current roof membrane Manufacturer's Reference Manual.
- D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.
- E. Correct deficiencies in roof as prescribed in current roof membrane Manufacturer's Reference Manual and as approved by Architect's Representative.

### **3.10 CLEANING AND PROTECTION**

- A. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.
- B. Remove bitumen stains from walls, walkways and driveways.
- C. Finished roof areas shall be protected from damage by the installer during construction.

**END OF SECTION**

## **SECTION 07 62 00 - ROOF RELATED SHEET METAL**

### **PART I – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. It is the intent of this Section that the Work shall:
  - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
  - 2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
    - a. Roof penetration sleeves and hood and umbrella counterflashing
    - b. Metal counterflashing
    - c. Expansion joint
    - d. Roof drains
    - e. Scuppers
    - f. Metal perimeter edge
    - g. Gutters, Downspouts, Splash Blocks and Splash Pans
    - h. One-way roof moisture relief vents
    - i. Metal gravity vents
    - j. Metal heat exhaust vents
    - k. Sanitary vent pipes
    - l. Pipe box
    - m. Copings, trim and miscellaneous sheet metal accessories.
  - 3. be part of the Work of the Roofing System; and
  - 4. be performed by a single source contractor.

#### **1.3 RELATED WORK**

- A. Section 07 52 19 - Modified Bitumen “Cool Roof” Membrane Roofing System
- B. Section 07 72 00 – Roof Accessories
- C. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

#### **1.4 REFERENCES**

- A. ASTM International (ASTM)
  - 1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
  - 2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
  - 3. B32, Standard Specification for Solder Metal
  - 4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. ASCE 7
- C. Federal Specifications (FS)
  - 1. QQ-L-201 for lead



- D. National Association of Architectural Metal Manufacturers (NAAMM)
- E. National Roofing Contractors Association (NRCA)
  - 1. Roofing and Waterproofing Manual
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
  - 1. Architectural Sheet Metal Manual
- G. ANSI / SPRI ES-1

#### **1.5 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.
- C. Samples:
  - 1) Full range of finish colors for Architect's selection.
  - 2) 12 inch long sample of each specified item with approved finish.
  - 3) Provide full size mockup of all shop built assemblies.
  - 4) Documentation of Wind uplift requirements for Roof Edge for specific project location
    - a. Wind Calculator available online

#### **1.6 QUALITY ASSURANCE**

- A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.
- B. Comply with governing codes and regulations of authorities having jurisdiction.
- C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 for minimum of up to 140 MPH (match project specific wind speed) wind speed zone and wind resistance loads.

#### **1.7 INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13, Project Coordination.

#### **1.8 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.
- B. Handle and store materials and equipment in such a manner as to avoid damage.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

#### **1.9 WARRANTIES**

- A. Manufacturer's Product Warranty:
  - 1) Manufacturer's standard 30 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
  - 2) Failure is defined to include, but not be limited to:
    - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
  - 3) Wind Warranty
    - a. Non Coastal: up to 160 MPH Blow Off Resistance, 20 Year
  - 4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
  - 5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.
- B. Roofing Contractor's Warranty:
  - 1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
  - 2. Defects shall include, but not be limited to:
    - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
    - b. Leaking water or bitumen within building or construction.
    - c. Becoming loose from substrate / blocking.
    - d. Loose or missing parts.
    - e. Finish failure as defined above.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design: Metal Era, Inc., which is located at: 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email:[request\\_info \(info@metalera.com\)](mailto:request_info@metalera.com); Web:[www.metalera.com](http://www.metalera.com)
- B. Substitutions: Before proposal date upon roof consultant approval.
- C. Requests for substitutions will be considered in accordance with provisions of Section 012513.
- D. Manufacturers named within specification are approved for use on the Project providing:
  - 1. their products meet or exceed the specifications;
  - 2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
  - 3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
  - 4. products are approved for use by the roofing membrane manufacturer.

### **2.2 SHEET METAL MATERIALS**

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.

- B. Prefinished Aluminum Sheet:
  - 1. Precoated type, aluminum conforming to Fed. Spec. QQ-A-250, ASTM B209.
  - 2. Thickness: Minimum 0.040 inch, except as otherwise indicated. SMACNA recommendations shall govern.
  - 3. Finish: Kynar 500, color as selected by Architect from manufacturer's full range of standard and premium colors.
- C. Prefinished Galvanized Sheet Steel:
  - 1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
  - 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
  - 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of standard and premium colors.
- D. Membrane Clad Sheet Steel:
  - 1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
  - 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
  - 3. Finish: PVC / TPO coating as per Membrane Manufacturer's requirements.
- E. Sheet Lead:
  - 1. Comply with FS QQ-L-201, Grade B
    - a. Four (4) pound minimum for use at roof drains and soil stacks.
- F. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

### 2.3 FASTENERS

- A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
  - 1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
  - 2. Washers: Steel washers with bonded rubber sealing gasket.
  - 3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
  - 4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.
- E. Clips:
  - 1. Cleat (coping / fascia): Minimum 22 gauge or .050 aluminum, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

### 2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
  - 1. Phosphoric acid type, manufacturer's standard.
    - a. For Use with Steel or Copper: Rosin flux

- b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
  - 1. 40 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting: Grace Ice and Water Shield HT, Soprema HT underlayment, Carlisle WIP 300 HT underlayment or similar product.
  - 2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.
- F. Sealant:
  - 1. Type A:
    - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
    - b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
  - 2. Type B:
    - a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
    - b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.
- G. Termination Bar:
  - 1. Material: Stainless steel or extruded aluminum bar with lipped profile.
  - 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
  - 3. Approved Product / Manufacturer: "TB 125" manufactured by TruFast Corp., or approved equal.
- H. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.
- I. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.
- J. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).
- K. Ventilated Roof Airflow Products Hi-Perf Vented Fascia by Metal-Era, Inc.

Hi-Perf Vented Fascia:

- (1) Construction:
  - (a) Metal:
    - (i) .040 inch (1.01 mm) aluminum.
    - (ii) .050 inch (1.27 mm) aluminum.
  - (b) Aluminum Finish:
    - (i) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
  - (c) Perforated Support Screen: 24 gauge formed steel with 54 percent free openings.
  - (d) Roof Flange and Backer Material: G90 Galvanized Steel with Formed Aluminum Studs.

## 2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.
- B. Comply with manufacturer's installation instructions and recommendations.
- C. Shop fabricate Thru-wall, counterflashings, expansion joint metal and wind clips to greatest extent possible.
- D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.
- E. Face of any fabricated vertical metal fascia or coping shall not exceed 8" without stiffener band or birds beak. If stiffener band or birds beak cannot be fabricate, contractor to use multiple pieces of metal to achieve overall distance without going over the 8" maximum per piece.
- F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.
- G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.
- H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
- I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.
- J. Fold back edges on concealed side of exposed edge to form hem.
- K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.
- L. Seams:
  - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
  - 2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
  - 3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

- M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- N. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

## 2.6 FABRICATED ITEMS

- A. Metal Flashings:
  - 1. Through Wall Receiver Tray: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than ¾".
  - 2. Counterflashings: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.
- C. Roof Penetrations:
  - 1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
  - 2. Flashing Pans:
    - a. 24 gauge stainless steel.
    - b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
    - c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
    - d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.
- D. Metal Edge / Fascia:
  - 1. Edge Systems One "One Gravel Stop" for Modified Bitumen Roof Systems: Features a continuous cleat with pre-slotted fastening holes and staggered openings in 40% of the roof flange.
    - 1) Metal:
      - a) .040 inch (1.01 mm) aluminum.
      - b) 24 gauge galvanized steel.
    - 2) Finish:
      - a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
    - 3) Fascia: Standard 12'-0" lengths with matching concealed joint splice plates.
    - 4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included

- 5) Performance:
  - a) 20 Year, 160 mph Wind Warranty. (Delete after verify)
  - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft<sup>2</sup> to comply with the International Building Code.
  - c) Factory Mutual approved I-285 for wind up lift protection.
  
- E. Metal Coping
  - 1. Perma-Tite Coping
    - 1) Construction:
      - a) Metal:
        - 1) .040 inch (1.01 mm) aluminum.
        - 2) 24 gauge galvanized steel.
      - b) Finish:
        - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
    - 2) Coping Cap: Length of 12'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
    - 3) Coping Vertical Face and Back Leg: 2 1/4" to 12 1/2" manufactured to job requirements.
    - 4) Concealed Splice Plates: 8" wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
    - 5) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
    - 6) Fasteners: 1 1/2" stainless steel with driver.
    - 7) Performance:
      - a) 20 Year, 140 mph Wind Warranty
      - b) Tested per ANSI / SPRI ES-1 Standard to comply with the International Building Code.
      - c) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".
  - 2. Creative Design Reveal Coping
    - 1) Construction:
      - a) Coping Cap: Length of 4'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
      - b) Coping Vertical Face and Back Leg: 2 1/4" to 12" manufactured to job requirements.
      - c) Concealed Splice Plates: 8 inch wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
      - d) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
    - 2) Fasteners: 1 1/2" Stainless Steel with driver.
  
- F. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
  
- G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.
  
- H. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.

- I. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.
- J. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
  1. Minimum 0.040 inch thick prefinished aluminum formed in maximum twelve (12) foot lengths.
  2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
  3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c., 1/8" Stainless Steel Pop Rivets, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
  4. Supply Drip Edge at gutter.
  5. For Modified Bitumen Systems: Include FlashThrough Drip Edge without Continuous Cleat.
  6. 24 gauge galvanized steel with membrane manufacturer's coating
  7. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
  8. Install all anchoring devices as outlined in manufacturer literature.
  9. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
  10. Gutter Straps and Supports: Minimum 3 per 12'-0" length, .100 inch thick downspout straps: Strap type, like metal, match color.
  11. Downspouts: Minimum 0.040 inch thick prefinished aluminum (match color).
  12. Downspout straps: Strap type, like metal, match color.
  13. Gutter Screen: .050" Aluminum with 1/4" dia. perforations
  14. Collect Heads: Minimum 0.040 inch thick prefinished aluminum (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify substrates are smooth and clean to extent required to perform sheet metal work.
- B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.
- C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.
- D. Do not start work until conditions are satisfactory.

#### **3.2 PREPARATION**

- A. Field measure site conditions prior to fabrication work.
- B. Install starter and edge strips and cleats before starting installation.

#### **3.3 INSTALLATION**

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or



transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:

1. Prefabricated corners;
  2. transitions;
  3. changes in direction, elevation, and plane; and
  4. at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
1. Ensure approved fasteners are used throughout the project.
  2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips and cleats.
  3. Ensure sufficient amount of waterblock is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**
- D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.
- E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
  2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
  3. Coordinate installation of through-wall flashing with the masonry contractor.
  4. Seal through-wall in conjunction with masonry wall waterproofing.
  5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- G. Pitch Pans, Metal Flanges (As Required):
1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
  2. Prime all metal flanges with asphalt primer prior to flashing installation.
  3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
  4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
  5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.
  6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of

SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.

- H. Sanitary Vent Stacks (As Required):
  - 1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
  - 2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.
- I. Gutters / Downspouts:
  - 1. Install gutters prior to edge metal and otherwise as detailed.
  - 2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer).
  - 3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

### **3.4 CLEANING AND PROTECTION**

- A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.
- B. Remove scraps and debris and leave work area clean.
- C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.
- D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.
- E. Paint metal flashings that have been soiled with bitumen with aluminized paint.
- F. Clean other work damaged or soiled by Work of this Section.
- G. Protect finished work from damage.

**END OF SECTION**

## **SECTION 07 65 00 - FLEXIBLE FLASHING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Provide flexible flashing where shown on drawings or required.

#### **1.3 RELATED SECTIONS**

- A. Section 03 30 00 – Cast-In-Place Concrete
- B. Section 04 20 00 – Unit Masonry
- C. Section 07 27 26 – Fluid Applied Air Barrier System
- D. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
- E. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer’s specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer’s installation instructions.
- B. Certification: Manufacturer’s affidavit that materials used in Project contain no asbestos.
- C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURER**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

#### **2.2 MATERIALS**

- A. Flashing:
  - 1. Copper Laminated Flashing (Contractor’s Option – in lieu of asphalt-free copper fabric flashing):
    - a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
      - 1) Modified asphalt compound coated.
      - 2) Asphalt saturated, waterproof glass fiber laminated fabric.

- b. Approved Manufacturers:
  - 1) Advanced Building Products, Inc.
  - 2) Hohmann & Barnard, Inc.
  - 3) Sandell Manufacturing Company, Inc.
  - 4) York Manufacturing, Inc.
- c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
- 2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of copper laminated flashing):
  - a. Glass fabric scrim bonded to a full sheet of copper for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
  - b. Approved Product / Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Fabric NA or Copper-Fabric SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
- 3. Asphalt-free Stainless Steel Flexible Flashing (Contractor's Option – in lieu of copper laminated or asphalt-free copper fabric flashing):
  - a. Flexible minimum 2 mil thickness, Type 304 steel sheet with factory applied adhesive with a release liner on one side for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
  - b. Approved Product / Manufacturer: York 304 as manufactured by York Manufacturing, Inc.; or Mighty-Flash-SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
- 4. Membrane Flashing:
  - a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by Manufacturer.
  - b. Approved Products / Manufacturers:
    - 1) "CCW-705 TWF" manufactured by Carlisle Coatings and Waterproofing
    - 2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
    - 3) "Blueskin TWF" manufactured by Henry Co.
    - 4) "Air-Shield Through wall flashing" manufactured by W.R. Meadows, Inc.
    - 5) "TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
    - 6) AquaFlash 500" manufactured by Fiberweb.
- 5. Substrate Primer: Provide as instructed by Membrane Manufacturer.
- 6. Termination Bar: 14 ga. minimum thick by 1" minimum wide stainless steel, with pre-punched holes and ¼" minimum shouldered top flange. Provide with self-tapping screws.
- 7. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw attach into wood blockings or substrate walls and strip into air barrier system.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Flashing:
  - 1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.

2. Application Guidelines - Install flashing at the following locations:
  - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
  - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
4. Provide drip edge flashing at weep conditions with membrane flashing. Cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
9. Lintel: Premolded or field molded end dams must be provided at each end of all lintels.
10. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
11. Heads, Jambs and Sills: Flashing for heads and sills shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded,

- NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
12. Windows: wrap all heads, sills and jambs into opening with flexible flashings.
  13. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
  14. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
  15. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut  $\frac{1}{4}$ " to  $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
  16. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
  17. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
  18. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
  19. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
  20. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
  21. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full  $\frac{1}{8}$  inch protective coating or mastic on all flashing faces.
  22. Lintels: Provide pre-molded end dams at all lintel ends.
- B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back  $\frac{3}{4}$  inch from face of masonry.

### 3.2 APPLICATION

- A. Protect membrane from overexposure to direct sunlight.
- B. Follow manufacturer's recommendations for installation.
- C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

**END OF SECTION 07 65 00**

## **SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Pre-finished galvanized steel gutters and downspouts.

#### **1.3 REFERENCE STANDARDS**

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Maintain one copy of each document on site.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on prefabricated components.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- D. Samples: Submit two samples, 6 inch (150 mm) long illustrating component design, finish, color, and configuration.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials that could cause discoloration, staining, or damage.

#### **1.7 WARRANTY**

- A. Manufacturer's Product Warranty:
  - 1. Manufacturer's standard 30-year finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
  - 2. Failure is defined to include, but not be limited to:
    - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
  - 3. Correction may include repair or replacement of failed product as outlined in Warranty Documents
  - 4. Finish warranty and wind warranty shall be delivered by the Contractor to the Owner at the conclusion of project as part of project closeout documents.
- B. Contractor's Warranty:

1. The Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the gutters and downspouts will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
2. Defects shall include, but not be limited to:
  - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
  - b. Leaking water or bitumen within building or construction.
  - c. Becoming loose from substrate / blocking.
  - d. Loose or missing parts.
  - e. Finish failure as defined above.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
  1. Gutters and Downspouts:
    - a. Alside, Inc: [www.alside.com/](http://www.alside.com/).
    - b. ATAS International, Inc.: [www.atas.com/](http://www.atas.com/).
    - c. Cheney Flashing Company: [www.cheneyflashing.com/](http://www.cheneyflashing.com/).
    - d. Drexel Metals Inc: [www.drexmet.com/](http://www.drexmet.com/).
    - e. Hickman Edge Systems: [www.hickmanedgesystems.com/](http://www.hickmanedgesystems.com/).
    - f. Metal-Era, an MTL Company: [www.metalera.com/](http://www.metalera.com/).
    - g. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc: [www.saf.com/persys/](http://www.saf.com/persys/).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  1. Manufacturers not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

### **2.2 MATERIALS**

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
  1. Finish: Shop pre-coated with modified silicone coating.
  2. Color: As indicated on Drawings.

### **2.3 COMPONENTS**

- A. Basis of Design: Seal-Tite Industrial Gutter IG-B manufactured by Metal-Era.
- B. General Requirements:
  1. Minimum 24-gauge prefinished galvanized steel, formed in maximum 12 foot lengths.
  2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
  3. Install all anchoring devices as outlined in manufacturer literature.
- C. Gutters:
  1. Profile as indicated on Drawings.
  2. Form in maximum lengths of 12 feet.
  3. Supply Drip Edge at gutter.
  4. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (PVC).
  5. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
  6. Gutter Straps and Supports: Minimum 3 per 12 foot length, 0.100 inch thick downspout straps: Strap type, like metal, match color.
- D. Downspouts:
  1. Profile as indicated on Drawings.
  2. Downspouts: Minimum 24-gauge prefinished galvanized steel (match color).
- E. Anchors and Supports:

#### **MANUFACTURED GUTTERS AND DOWNSPOUTS**

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1. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets, and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
  2. Anchoring Devices: As recommended by fabricator.
  3. Gutter Supports: 2 inch Wide Gutter Straps at 24 inches o.c., Wind Straps 6 feet o.c., 1/8 inch Stainless Steel Pop Rivets, and #10 by 2 inch Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer..
  4. Downspout Supports: Strap type, like metal, match color.
- F. Accessories:
1. Downspout Boots: Refer to Section 05 50 00 - Metal Fabrications.
  2. Downspout Guards: Refer to Section 05 50 00 - Metal Fabrications.

## **2.4 FABRICATION**

- A. Form gutters and downspouts of profiles and size(s) indicated on Drawings.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

## **2.5 FINISHES**

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as selected by Architect from manufacturer's standard colors.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

### **3.2 PREPARATION**

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

### **3.3 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- D. Connect downspouts to downspout boots above grade. Grout connection watertight.

**END OF SECTION**

## **SECTION 07 22 00 - ROOF ACCESSORIES**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 INSTALLATION RESPONSIBILITY**

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
  - 1. Roofing
  - 2. Roofing sheet metal
  - 3. Mechanical equipment
  - 4. Plumbing
  - 5. Electrical

#### **1.3 REFERENCES**

- A. Federal Specifications (FS)
  - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
  - 1. Architectural Sheet Metal Manual

#### **1.4 SUBMITTALS**

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- C. Contractor to provide proof of membrane material compatibility for roof bracing and supports.(Refer to section 2.6)

#### **1.5 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 13 – Project Coordination.

#### **1.6 WARRANTY**

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
  - 1. Noticeable deterioration of finish
  - 2. Water infiltration into the building or within the construction.

- C. Rooftop supports – 5 year limited warranty.
- D. Roof bracing – 20 year limited warranty included in roofing warranty.
  - 1. Water infiltration into the building or within the construction.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

### **2.2 PREFABRICATED ROOF CURBS**

- A. Frames:
  - 1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
    - a. Minimum 18 gauge, and as engineered by manufacturer.
    - b. Minimum 18 gauge for curbs supporting HVAC units
    - c. Minimum 20 gauge for expansion joint curbs.
  - 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
  - 3. Base Plates: Integral to frame and welded.
  - 4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
  - 5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
  - 1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- E. Counterflashing: 24 gauge stainless steel
- F. Counterflashing Cap: Stainless steel.
- G. Cants:
  - 1. Non-canted curb style installs either under or on top of metal decks with insulation.
  - 2. Cants shall be provided under Section 07 52 19 – Roofing
- H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.
- I. Approved Manufacturers:

1. Custom Curb, Inc.
2. Roof Products, Inc.

### **2.3 PIPE SUPPORTS (Contractor built supports are not allowed)**

- A. Gas Pipe Supports:
1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3" O.D. and smaller.
  2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3" O.D.
  3. Acceptable Manufacturers: PHP Portable Pipe Hanger or Architect approved equal.
- B. Electrical Conduit / Condensate Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless steel channel, rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3" O.D. and smaller.
  2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3" O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
  4. Acceptable Manufacturers: PHP Portable Pipe Hanger or Architect approved equal.
- C. Chilled Water Pipe Supports:
1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
  5. Acceptable Manufacturers: PHP Portable Pipe Hanger or Architect approved equal.
- D. Crossover / Steps Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors and stainless steel channel, rods, washers and nuts; Basis of design, PHP Crossover.
  6. Acceptable Manufacturers: PHP Portable Pipe Hanger or Architect approved equal.
- E. Installation:
1. Provide pipe supports at no greater than 8'-0" o.c. or as otherwise indicated in Manufacturer's Shop Drawings.
  2. Provide pipe supports spaced so deflection of piping does not exceed 1/240 of span. If deflection exceeds 1/240 of span, decrease support spacing to 6'-0" o.c.
  3. Provide complete and adequate support of all piping, ducts and conduit.

4. Provide protective isolation pads adhered to the roof system below each pipe support using Roof System Manufacturer's approved adhesive.
5. Provide each pipe support adhered to the protective isolation pads using Roof System Manufacturer's approved adhesive.

## 2.4 ROOF TO ROOF EXPANSION JOINT

- A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

## 2.5 RETROFIT ROOF DRAINS

- A. Retrofit Roof Drains: "Hercules RetroDrain" as manufactured by OMG, Inc. or Architect approved equal.
  1. Size: To match existing roof drain sizes. [3 inches] [4 inches] [5 inches] [6 inches] [Indicated on the Drawings].
  2. Compliance:
    - a. ANSI / SPRI RD-1.
    - b. ULC / ORD-C790.4.
  3. Drain Body:
    - a. Material: 1-piece, 11-gauge (0.125-inch) spun aluminum.
    - b. Flange: 17-1/2-inch diameter.
  4. Drain Stem Length: 12 inches
  5. Flange Includes: Six 2-1/2-inch-long aluminum studs.
  6. Sump Area: Depressed.
- B. Strainer Dome:
  1. Material: Cast aluminum.
  2. Height: 7.25 inches.
  3. Outside Base Diameter: 9.77 inches.
- C. Clamping Ring:
  1. Material: Cast aluminum.
  2. Gravel Stop Height: 1.2 inches.
  3. Drainage Slots: 18 V-shaped.
  4. Bosses: 6, to accept studs on flange.
- D. Backflow Seal:
  1. Compression Seal: Watertight, "U-Flow" mechanical seal.
  2. Material: Polyamide and EPDM rubber.
  3. Required for Activation: "U-Flow" screwdriver.
- E. Hardware:
  1. Locknuts: 6, stainless steel, for studs.
  2. Screws: 3, stainless steel, to attach strainer to clamping ring.
- F. Overflows:
  1. At overflow locations; provide overflow collar extension
  2. Constructed of spun aluminum

## 2.6 MISCELLANEOUS ROOF BRACING AND SUPPORT SYSTEMS

- A. Provide U-Anchors made of 304 stainless steel with 3/8" bolt and galvalume plate. Utilize same membrane as roofing manufacturer to be inclusive in 20 YEAR NDL warranty

- B. As manufactured by Anchor Products Model U-anchor 2000 Series as required for condition or nVent Caddy Pyramid Anchor system

## **2.7 ROOF PENETRATION HOUSING**

- A. Provide rain-proof four-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and water tight. To be used with our exclusive two-piece aluminum and / or stainless steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.
- B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

## **2.8 ROOF DRAIN / DOWNSPOUT WALL NOZZLE**

- A. Downspout Wall Nozzle at Concealed Roof Drain Leader / Discharge: Josam 25010 Series cast bronze Downspout Nozzle with loose flange and inlet threaded connection or Architect approved equal. Diameter appropriate to downspout size.

## **2.9 PLUMBING PEDESTAL HYDRANT**

- A. Provide freeze-proof pedestal hose station / hydrant with stainless steel shroud, welded stainless steel flange, black powder coated cast aluminum dome handle, mail hose fitting and vacuum breaker. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.
- B. As manufactured by MAPA Products Model MPH-24D:24/9 Pedestal Hydrant as required for condition or Architect approved equal.

## **2.10 ELECTRICAL PEDESTAL DISCONNECT / OUTLET**

- A. Provide rain-proof pedestal disconnect with stainless steel square tubing and welded stainless steel flange. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.
- B. As manufactured by MAPA Products Model MPD-(XX) Pedestal Disconnect as required for condition or Architect approved equal.

# **PART 3 - EXECUTION**

## **3.1 INSTALLATION**

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.
- B. Coordinate with roofing operation for watertight integrity.
- C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

**END OF SECTION**

## **SECTION 07 81 00 – CEMENTITIOUS FIREPROOFING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Sprayed fire resistive materials.
  - 2. Accessories necessary for a complete installation.

#### **1.3 RELATED DOCUMENTS**

- A. Section 07 21 00 – “Thermal Insulation.”
- B. Section 07 81 23 – “Intumescent Fireproofing.”

#### **1.4 DEFINITIONS**

- A. SFRM: Sprayed fire resistive materials.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Fire Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Steel members shall be considered to be unrestrained unless specifically noted otherwise.
  - 2. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor are not allowed.
- C. Asbestos: Provide products containing no detectable asbestos.
- D. Dry mix inorganic spray-applied fire resistive material containing mineral slag wool and Portland-cement are not permitted.

#### **1.6 SUBMITTALS**

- A. Product Data: Technical data, installation instructions, and UL listing for each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
  - 1. Extent of fireproofing for each construction and fire resistance rating.
  - 2. Applicable fire resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 3. Minimum fireproofing thickness necessary to achieve required fire resistance rating of each structural component and assembly.

4. Treatment of fireproofing after application.
- C. Samples: Submit for each exposed product and for each color and texture specified, 4 inches (102 mm) square in size.
- D. Product Certificates and Reports:
  1. Certificates: Submit manufacturer's precut certificates for each type of SFRM.
  2. Evaluation Reports: Submit ICC-ES evaluation report.
  3. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating:
    - a. Materials have been tested for bond with substrates.
    - b. Materials have been verified by SFRM manufacturer to be compatible with substrate and coatings.
    - c. Interpretation of test results and written recommendations for substrate preparation needed for adhesion.
  4. Preconstruction test reports.
  5. Field quality control reports.

## 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  1. Building Code: Comply with applicable provisions of the IBC for fire protection.
  2. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame Spread Index: 10 or less.
    - b. Smoke Developed Index: 10 or less.
- B. Installer Qualifications: A firm or individual having minimum 5 years documented experience who is certified or licensed and qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- C. Source Limitations: Obtain fireproofing for each fire resistance design from single source.
- D. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
  1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified.
  3. Verify that manufacturer, through its own laboratory testing or field experience, attests that coatings are compatible with fireproofing.
  4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures.
- E. Preinstallation Conference: Conduct conference at site.
  1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life, and fire resistance ratings applicable to Project.



- B. Use materials with limited shelf life within period indicated. Remove from site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from site and discard wet or deteriorated materials.

### **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 degrees F (7 degrees C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

### **1.10 COORDINATION**

- A. Sequence and coordinate application of sprayed fireproofing with related work to comply with requirements:
  - 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
  - 2. Provide temporary enclosures for applications to prevent deterioration of fire resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
  - 3. Avoid unnecessary exposure of fire resistive material to abrasion and damage likely to occur during construction operations subsequent to its application.
  - 4. Do not apply fire resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire resistive material to metal deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire resistive material.
  - 5. Do not apply fire resistive material to metal floor deck substrates until concrete topping has been completed.
  - 6. Do not begin applying fire resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
  - 7. Defer installing ducts, piping, and other items that would interfere with applying fire resistive material until application of fire protection is completed.
  - 8. Do not install enclosing or concealing construction until after fire resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

### **1.11 WARRANTY**

- A. Written warranty signed by installer, and Contractor in which manufacturer agree to repair or replace fireproofing materials that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
    - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire response testing, and other causes not reasonably foreseeable under conditions of normal use.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Basis of Design: Isolatek International. Other manufacturers are subject to compliance with requirements.
1. Grace Construction Products.
  2. Carbolite Company; a subsidiary of RPM International.
  3. Southwest Fireproofing Products Co.
- B. Sprayed Fire Resistive Material: Factory mixed, lightweight, dry formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.
1. Application: Interior locations not exposed to damage or moisture.
  2. Bond Strength: Minimum 150 lbf/sq. ft. (7.18 kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
  3. Density: Not less than density specified in the approved fire resistance design, according to ASTM E 605.
  4. Thickness: As necessary required for fire resistance design indicated, measured according to requirements of fire resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
  5. Compressive Strength: Minimum 1,400 psf (68.9 kPa) according to ASTM E 761.
  6. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
  7. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
  8. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
  9. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
  10. Fungal Resistance: Treat products with antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.
  11. Finish: Spray textured finish unless otherwise indicated.
  12. Basis of Design: CAFCO 300 Series as manufactured by Isolatek or comparable product.
- C. Sprayed Fire Resistive Material: Factory mixed, lightweight, wet formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.
1. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
  2. Bond Strength: Minimum 1000-lbf/sq. ft. (47.88-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
  3. Density: Not less than 40 lb/cu. ft. (640 kg/cu. m) as specified in the approved fire-resistance design, according to ASTM E 605.
  4. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design
  5. Combustion Characteristics: When tested in accordance with ASTM E 136 shall be noncombustible
  6. Surface-Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
    - a) Flame Spread Index: 0.
    - b) Smoke Developed: 0.
  7. Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than 10 percent when subjected to a crushing force of 43,200 psf (2068 kPa).

8. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
  9. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
  10. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
  11. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
  12. Fungal Resistance: When tested in accordance with ASTM G21, the material shall show resistance to mold growth for a minimum period of 28 days with or without the use of a mold inhibitor.
  13. Finish: Spray textured finish unless otherwise indicated.
  14. Basis of Design: Isolatek Fendolite M-II or comparable product.
- D. Auxiliary Materials: Provide auxiliary materials compatible with fireproofing and substrates and approved by UL for use in fire resistance designs indicated.
1. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in *UL Fire Resistance Directory*.
  2. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire resistance designs indicated and fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
  3. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire resistance designs indicated; approved and provided by fireproofing manufacturer.
  4. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions for compliance with requirements for substrates and conditions affecting performance of the work and according to each fire resistance design.
1. Verify substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
  2. Verify objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  3. Verify substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
  4. Verify concrete work on steel deck is complete before beginning fireproofing work.
  5. Verify roof construction, installation of rooftop HVAC equipment, and related work are complete before beginning fireproofing work.
  6. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
  7. Prepare written report listing conditions detrimental to performance of the work.
  8. Proceed with installation after correcting unsatisfactory conditions.
- B. Conduct tests according to fireproofing manufacturer's written recommendations to verify substrates are free of substances capable of interfering with bond.
- C. Prepare written report listing conditions detrimental to performance of the work.
- D. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 PREPARATION**

- A. Cover adjacent work subject to damage from fallout or overspray of fireproofing materials during application. Clean substrates of substances that could impair bond of fireproofing.
- B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless in satisfactory condition to receive fireproofing.
- C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

### **3.3 APPLICATION**

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
  - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
  - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
  - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
  - 2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
  - 1. For applications over encapsulant materials, including lockdown (post removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
  - 2. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.

- H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
  - 1. Cure fireproofing according to fireproofing manufacturer's written instructions.
- I. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- J. Cure fireproofing according to fireproofing manufacturer's written instructions.
- K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
  - 1. Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
  - 2. Spray Textured Finish: Finish left as spray applied with no further treatment.
  - 3. Rolled, Spray Textured Finish: Even finish produced by rolling spray applied finish with a damp paint roller to remove drippings and excessive roughness.
  - 4. Skip Troweled Finish: Even leveled surface produced by troweling spray applied finish to smooth out the texture and neaten edges.
  - 5. Skip Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray applied finish to smooth out the texture, eliminate surface markings, and square off edges.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Test and inspect as required by the applicable building code.
- B. Perform the tests and inspections of completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
  - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
  - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### **3.5 CLEANING, PROTECTING, AND REPAIRING**

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.

- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel applied product.

**END OF SECTION 07 81 00**

## **SECTION 07 84 13 - PENETRATION FIRESTOPPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.

#### **1.3 ALLOWANCES**

- A. Penetration firestopping Work is part of an allowance.

#### **1.4 UNIT PRICES**

- A. Work of this Section is affected by unit prices.

#### **1.5 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.6 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

#### **1.7 CLOSEOUT SUBMITTALS**

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

## **1.9 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## **1.10 COORDINATION**

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

## **1.11 WARRANTY**

- A. Written warranty signed by manufacturer, installer, and Contractor in which manufacturer agree to repair or replace firestopping materials that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Two (2) years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."
      - 3) FM Global in its "Building Materials Approval Guide."

### **2.2 PENETRATION FIRESTOPPING SYSTEMS**

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.



- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
  - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  - 1. Permanent forming/damming/backing materials.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.

### **2.3 FILL MATERIALS**

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

## **2.4 MIXING**

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### **3.3 INSTALLATION**

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### **3.4 IDENTIFICATION**

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
  - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### **3.5 FIELD QUALITY CONTROL**

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

**3.6 CLEANING AND PROTECTION**

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

**END OF SECTION 07 84 13**

## **SECTION 07 84 43 - JOINT FIRESTOPPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Joints in or between fire-resistance-rated constructions.
  - 2. Joints at exterior curtain-wall/floor intersections.
  - 3. Joints in smoke barriers.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

#### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Standard for the Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."

### 2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
  - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
  - 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

#### **3.3 INSTALLATION**

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

#### **3.4 IDENTIFICATION**

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-

type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### **3.5 FIELD QUALITY CONTROL**

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### **3.6 CLEANING AND PROTECTION**

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

**END OF SECTION 07 84 43**



## **SECTION 07 92 00 – JOINT SEALANTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Control and expansion joints on exposed surfaces.
  2. Perimeter joints between wall surfaces and frames of doors and openings.
  3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
  4. Joints indicated or as necessary.
  5. Accessories necessary for a complete installation.

#### **1.3 RELATED SECTIONS**

- A. Section 04 20 00 – Unit Masonry.
- B. Section 08 80 00 – Glazing.
- C. Section 09 21 16 – Gypsum Board Assemblies
- D. Section 09 30 13 – Ceramic Tiling.
- E. Section 09 30 16 – Quarry Tiling.
- F. Section 09 30 19 – Porcelain Tiling.
- G. Division 23 – Mechanical Sections.

#### **1.4 REFERENCES**

- A. ASTM International (ASTM)
  1. C717, Standard Terminology of Building seals and Sealants.
  2. C793, Standard Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
  3. C794, Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
  4. C834, Standard Specification for Latex Sealants.
  5. C920, Standard Specification for Elastomeric Joint Sealants.
  6. C1193, Standard Guide for Use of Joint Sealants.
- B. Sealant, Waterproofing and Restoration Institute (SWRI)
  1. The Professional's Guide.

#### **1.5 SUBMITTALS**

- A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.

1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
    - a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
    - b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
    - c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.
  2. Recycled Content:
    - a. Indicate recycled content; indicate percentage of preconsumer and postconsumer recycled content per unit of product.
    - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
    - c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
    - d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
  3. Local/Regional Materials:
    - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
    - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
    - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
    - d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.
  4. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
  5. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- B. Certificates and Reports:
1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
  2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
  3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
  4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
    - a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
    - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
  5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
  6. Field Adhesion Test Reports: For each sealant application tested.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
  2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.
- B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  2. Pre-construction Field Adhesive Testing: Prior to installation of building sealants, field test their adhesion to joint substrates in accordance with manufacturer's instructions. Perform test in locations indicated by Architect. Perform test for each type of building sealant and each substrate as required by Architect. If required by Architect, arrange for tests to be performed with sealant manufacturer's representative present. Follow-up review by Architect and manufacturer may be required to observe sealant performance over time and may result in re-application of sealant or replacement.
  3. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.
- D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
    - a. VOC Content of Interior Sealants: Sealants and sealant primers complying with limits for VOC content for SCAQMD when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      - 1) Sealants: 250 g/L.
      - 2) Sealant Primers for Nonporous Substrates: 250 g/L.
      - 3) Sealant Primers for Porous Substrates: 775 g/L.
    - b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.
- E. Cleaning: Facade sealants that have collected dirt at the time of Substantial Completion shall be cleaned over the entire facade prior to acceptance by the Owner. 11 months after final completion of the building, if the sealant joints show dirt, they shall again be cleaned over the entire façade.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
  - 2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

## 1.9 PRE-INSTALLATION CONFERENCES

- A. Refer to Section 01 31 00 – Project Management and Coordination.
- B. In addition, refer to information above concerning Field Adhesive Testing.

## 1.10 WARRANTY

- A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Warranties specified exclude deterioration or failure of sealants from:
  - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.

- B. Liquid Applied Sealants: Comply with ASTM C 920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide nonstaining products that have undergone testing according to ASTM C 1248 and do not stain porous joint substrates.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface. For exposed joints, submit color samples to architect for approval, from manufacturer's full line of standard colors.
- F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.
- G. Sealants: Self leveling compounds for horizontal joints in pavements and nonsag compounds elsewhere except as shown or specified.
- H. Silicone Sealant: Comply with ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
  - 1. Use: Precast Concrete Joints between metals, glass and plastics (Two part silicone sealants).
  - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
  - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
  - 4. Product and Manufacturer:
    - a. Dow Corning; 756 Silicone Building Sealant - HP with Additive or MasterSeal 121 by Masters Builders Solutions or Sikasil by Sika Corporation
- I. Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
  - 1. Use: Precast Concrete Joints between metals, glass and plastics (Single component sealants).
  - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
  - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
  - 4. Product and Manufacturer:
    - a. Master Builders Solutions
    - b. ; Omniseal 50.
    - c. Dow Corning Corporation; 756 SMS, 791, 795, 995 as applicable.
    - d. GE Advanced Materials, Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 as applicable.
    - e. Sika Corporation, Construction Products Division; SikaSil-C995.
- J. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
  - 1. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
  - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.

3. Products and Manufacturers:
  - a. Masters Builders Solutions; MasterSeal NP 2.
  - b. Pecora Corporation; Dynatred.
  - c. Sika Corporation, Construction Products Division; Sikaflex 2c NS or Sikaflex 2c NS TG as applicable.
  
- K. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
  1. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
  2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
  3. Products and Manufacturers: One of the following:
    - a. Schnee-Morehead, Inc.; Permthane SM 7200.
    - b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
    - c. Masters Builders Solutions; NP 2.
  
- L. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
  1. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.
  2. Products: Provide one of the following:
    - a. Master Builders Solutions; Omniplus.
    - b. Dow Corning; 786 Mildew Resistant Silicone Sealant.
    - c. GE Silicones; Sanitary SCS 1700.
  
- M. Latex Sealant: Nonelastomeric, one part, nonsag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C 834, Type OP (opaque sealants):
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; AC-20 + Silicone.
    - b. Masters Builders Solutions; MasterSeal.
  
- N. Acoustical Joint Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; AC-20 FTR or AIS-919.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.
  
- O. Sealant Backing: Provide sealant backings that are nonstaining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  1. Cylindrical Sealant Backings: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
  2. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state; one of the following:
    - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
    - b. MasterSeal 920 Closed-Cell Backer-Rod; Master Builders Solutions.
  
- P. Weep and Vent Tubes: Clear plastic (PVC) tubing, minimum 1/4 inch (6.35 mm) inside diameter, and length required to extend between exterior face of sealant and open cavity

behind. At window and curtain wall systems, where required by system designer, provide gutter termination of tube with preformed nipples suitable for sealing to gutter.

Q. Miscellaneous Materials:

1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
4. Cork Joint Filler: Resilient and nonextruding, ASTM D1752, Type II.
5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
  2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
  3. Remove laitance and form-release agents from concrete.
  4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming (Elastomeric Sealants Only): Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION

- A. Silicone Glazing Sealants: Refer to Section 08 80 00.
- B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- C. Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants applicable to materials, applications, and conditions indicated.
- D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
  - 4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.
- E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.
- F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
  - 1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
  - 2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
  - 3. Apply nonelastomeric sealants to a depth approximately equal to the joint width.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
  - 1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
  - 2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
  - 3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.
- H. Installation of Preformed Silicone Sealant System:
  - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
  - 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone sealant system manufacturer's written instructions and covering a



- bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
  4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- J. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer written recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
1. Extent of Testing: Test completed and cured sealant joints:
    - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
    - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.
  4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
  5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

**3.5 SITE ENVIRONMENTAL PROCEDURES**

- A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

**3.6 CLEANING AND PROTECTION**

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

**END OF SECTION 07 92 00**

## **SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.
- B. Related Sections:
  - 1. Section 05 50 00 - Metal Fabrications: Custom fabricated metal expansion and control joint devices.
  - 2. Section 07 62 00 - Roof Related Sheet Metal: Roof expansion and control joint covers.
  - 3. Section 07 72 00 - Roof Accessories: Roof expansion and control joint covers.
  - 4. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
- D. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- E. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Architectural Art Mfg, Inc: [www.archart.com/#sle](http://www.archart.com/#sle).
  - 2. Balco, Inc.: [www.balcousa.com/#sle](http://www.balcousa.com/#sle).
  - 3. Construction Specialties, Inc: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).
  - 4. EMSEAL Joint Systems, Ltd: [www.emseal.com/#sle](http://www.emseal.com/#sle).
  - 5. Inpro: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
  - 6. MM Systems Corp: [www.mmsystemscorp.com/#sle](http://www.mmsystemscorp.com/#sle).
  - 7. Nystrom, Inc: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).

8. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
9. SITURA Inc: [www.situra.com/#sle](http://www.situra.com/#sle).
10. Watson Bowman Acme Corporation: [www.watsonbowmanacme.com/#sle](http://www.watsonbowmanacme.com/#sle).

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

## **2.2 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS**

- A. Interior Floor Joints Subject to Thermal Movement (EJC-1):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. Balco, Inc; No-Bump Floor to Floor System, Aluminum (NBAF).
    - b. Construction Specialties, Inc; Allway Standard Metal Floor Covers.
    - c. Watson Bowman Acme Corporation; Wabo CorridorWrap Floor.
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement (EJC-3):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. Balco, Inc; Wall and Ceiling Snap-On Joint Cover (WD).
    - b. Construction Specialties, Inc; Allway Standard Wall and Ceiling Covers.
- C. Interior Non-Fire-Rated Wall/Ceiling Joints Subject to Seismic Movement (EJC-4):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. Construction Specialties, Inc; Flush Seismic Wall and Ceiling Covers.
- D. Interior/Exterior Fire-Rated Wall Joints Subject to Thermal Movement (EJC-8):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. EMSEAL Joint Systems, Ltd; Emshield WFR2 System.
- E. Exterior Wall Joints Subject to Thermal Movement (EJC-9):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. Construction Specialties, Inc; Exterior Wall Covers.
    - b. EMSEAL Joint Systems, Ltd; BG System.
    - c. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- F. Exterior Roof Bellows with Metal Flange Expansion Joint Covers (EJC-11):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. Balco, Inc; Roof Bellows, Aluminum Flanges (BRBA).
- G. Exterior Roof Expansion Joint Covers (EJC-12):
  1. Basis of Design Manufacturer(s) and Product(s):
    - a. Balco, Inc; Roof Metal Plate System, with Canted Curb (LPR).
    - b. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- H. Below Grade, Blind-Side and Positive-Side, and Under-Slab Joints (EJC-16):
  1. Basis of Design Manufacturer(s) and Product(s):

## **2.3 EXPANSION JOINT COVER ASSEMBLIES**

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
  1. Joint Dimensions and Configurations: As indicated on drawings.
  2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
  3. Joint Cover Styles: As indicated on Drawings.
  4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
  5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
  6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
  1. If floor covering is not indicated, obtain instructions from Architect before proceeding.

2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.
- D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.
- E. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- F. Covers in Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

## 2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
  1. Exposed Finish Outdoors: Natural anodized.
  2. Exposed Finish at Floors: Mill finish or natural anodized.
  3. Exposed Finish at Walls and Ceilings: Natural anodized.
- B. Resilient Seals:
  1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
  2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
  3. Color: Gray.
- C. Anchors and Fasteners: As recommended by cover manufacturer.
- D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- E. Threaded Fasteners: Aluminum.
- F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

## 2.5 ACCESSORIES

- A. Resilient Fire Barrier: For use with metal expansion joint covers and elastomeric seals without use of mechanical fasteners, with fire rating in accordance with surrounding construction performance capabilities.
  1. Application: Roof.
  2. Fire Resistance Rating: 2-hour, in accordance with ASTM E1966 and UL 2079.
  3. Manufacturer(s) and product(s):
    - a. Balco, Inc; Expansion Joint Fire Barrier, Floor/Roof - MetaBlock, 2 Hour (MBF2H).

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

### 3.2 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Install expansion joints in accordance with TCA publication EJ171.
- C. Align work plumb and level, flush with adjacent surfaces.
- D. Rigidly anchor to substrate to prevent misalignment.

**3.3 PROTECTION**

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

**END OF SECTION 07 95 13**

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Provide items shown on the drawings and specified, including, but not limited to the following:
  - 1. Standard and fire rated hollow metal doors
  - 2. Hollow metal frames for doors, sidelites, transoms, and windows.
  - 3. Louvers and vision lites in steel doors, if shown or required.

#### **1.2 RELATED WORK**

- A. Section 04 20 00 - Unit Masonry.
- B. Section 05 40 00 – Cold-Formed Metal Framing.
- C. Section 05 50 00 – Metal Fabrications.
- D. Section 08 14 23 – Plastic-Laminate-Faced Wood Doors.
- E. Section 08 80 00 - Glazing: Glazing in doors, sidelites, transoms, and windows.
- F. Section 09 90 00 - Paintings and Coatings.

#### **1.3 REFERENCES**

- A. American National Standards Institute (ANSI)
  - 1. A115.IG, Installation Guide for Doors and Hardware.
  - 2. A224.1, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors & Frames.
  - 3. A250.8, Recommended Specifications for Standard Steel Doors and Frames.
  - 4. A250.11, Recommended Erection Instructions for Steel Frames.
- B. ASTM International (ASTM)
  - 1. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 2. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - 3. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
  - 4. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - 5. C1363 - Standard Test Method for the Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.

6. E283 – Standard Test Method for Determining the rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  7. E413 - Standard Classification for Rating Sound Insulation
- C. Federal Specification (Fed Spec)
1. Fed Spec C578 Bead Fusion Test.
- D. Hollow Metal Manufacturers Association (HMMA)
1. HMMA 802 - Manufacturing of Hollow Metal Doors and Frames.
  2. HMMA 810 - Hollow Metal Doors.
  3. HMMA 830 - Hardware Preparation and Locations for Hollow Metal Doors and Frames.
  4. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames.
  5. HMMA 850 - Fire Rated Hollow Metal Doors & Frames.
  6. HMMA 890 - Technical Summary of Hollow Metal by HMMA.
- E. National Fire Protection Association (NFPA)
1. 80, Fire Doors and Fire Windows.
  2. 252, Fire Tests of Door Assemblies.
- F. Steel Door Institute – Current Standards
1. Technical Data Series.
- G. Underwriters Laboratories Inc. (UL)
1. Building Materials Directory.
  2. Listing and Labeling.
  3. 10B and 10C, Fire Tests of Door Assemblies.
  4. 1784, Air Leakage Tests of Door Assemblies.
- H. Intertek Testing, Services (Warnock Hersey, Inc. (WHI))
1. Listing and Labeling.

#### 1.4 SUBMITTALS

- A. Product Data:
1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
  2. Manufacturer's installation instructions.
- B. Shop Drawings:
1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the Contract Drawings. If any door is not by the steel door manufacturer only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.).
  2. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
1. 12 inch x 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
  2. 12 inch x 12 inch sample of each type of door louver specified or required, showing louver construction.
  3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.



- D. Certificates:
  - 1. Manufacturer's certification that oversized openings are in compliance with specifications.

### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: If other than a manufacturer listed under Paragraph 2.1 is proposed for use on the Project, it shall be a company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of five (5) years experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. ANSI/SDI-A250.13 (2003) Testing and Rating of Sever Windstorm Resistant Components for Swing Door Assemblies.
- E. ASTM E 330-97, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- F. Comply with ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

### 1.6 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies:
  - 1. Fire-Rated Door, Panel, Frame, and Fire Window Construction: Shall conform to ASTM E2074, NFPA 252, or UL 10B, as applicable, and acceptable to the code authorities having jurisdiction.
  - 2. Fire-Rated Door Construction:
    - a. Notwithstanding any other requirements of this Specification, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20 minute, 45 minute, 1 hour, 1-1/2 hour, 3 hour, etc.) and the designation (A, B, C, D, or E). Doors with "B" Label shall be 1-1/2 hour.
    - b. Fire-rated doors used in a stairway enclosure, shall be so constructed so that the maximum transmitted temperature shall not exceed 450 degrees F above ambient temperature at the end of 30 minutes of the Standard Fire Exposure Test and shall be so noted on the label.
  - 3. Fire-Rated Openings: Conform to NFPA 80 for fire-rated class shown or required by code authorities having jurisdiction.
    - a. Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified under Paragraph C, 01, above, and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code authorities having jurisdiction.
    - b. Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.
    - c. Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.

- d. Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.
  - e. Locate label on hinge side of doors and frames so that when door is closed, label is not visible.
  - f. Caution shall be taken to ensure that labels are not removed, damaged or painted over.
  - g. Glass panes shall not exceed sizes allowed whether indicated or not on the drawings.
- B. Wind Loads: Provide hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding windload design pressures which are calculated for this project by a registered Architect or Engineer and is part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction and the International Building Code Design Loads per section 1609.
- C. Hurricane-Resistance Test Performance: Provide hollow metal and door hardware approved assemblies that pass large missile-impact tests, as required by Texas Department of Insurance systems location above grade, and cyclic-pressure tests according to testing requirements of authorities having jurisdiction.
- 1. Impact Resistance: Hollow metal with approved door hardware assemblies must satisfy the Texas Department of Insurance's criteria for protection from windborne debris in both the Inland 1 zone and the Seaward zone. The assemblies must have passed the large missile impact test (which equates to Missile Level D specified in ASTM E 1996-02). The assemblies may be installed at any height on the structure as long as the design pressure rating for the assemblies is not exceeded. These assemblies will and do not need to be protected with an impact protective system when installed in areas where windborne debris protection is required.

#### **1.7 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 – Project Management and Coordination.

#### **1.8 COORDINATION**

- A. Coordinate the Work of this Section with Work in which hollow metal Work is installed.
- B. Coordinate hardware installation with opening construction. Finish hardware is specified in Section 08 71 00.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00.
- D. Coordinate doors and frames with painting specified in Section 09 91 00.

#### **1.9 DELIVERY, STORAGE AND HANDLING**

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
  - 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
  - 2. Containers or wrappers shall list the name of the manufacturer and product.
- B. Deliver materials to allow for minimum storage time at the project site. Coordinate delivery with the scheduled time of installation.
- C. Protect products from moisture, construction traffic, and damage.
  - 1. Store under cover in a clean, dry place, protected from weather and abuse.

2. Store in a manner that will prevent rust or damage.
3. Store doors in a vertical position, spaced with blocking to permit air circulation.
4. Do not use non-vented plastic or canvas shelters.
5. Should containers or wrappers become wet, remove immediately.

#### **1.10 WARRANTY**

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
  1. Use of incorrect materials in opening
  2. Incorrect labeled components installed within opening.
  3. Noisy, rough or difficult operation
  4. Failure to meet specified quality assurance requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must comply with Paragraph 1.5, A, Manufacturer Qualifications, must manufacture equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
  1. CECO Door Products, an Assa Abloy company. (888-264-7474).
  2. Curries Company, an Assa Abloy company. (641-423-1334).
  3. Deansteel Mfg. Co.; (210) 226-8271.
  4. Door Pro Systems, Inc., (713) 462-0860.
  5. Mesker Door Inc.; (256) 851-6670.
  6. Pearland Industries; (713) 434-9898.
  7. Pioneer Industries, Inc.; (309) 856-6000.
  8. Republic Builders Products Company; (800) 733-3667.
  9. Steelcraft Mfg. Co., an Allegion company; (513) 745-6400.

#### **2.2 MATERIALS, GENERAL**

- A. Steel requirements, all frames to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel per ASTM-A1008 general requirements. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A1011. Exterior frames and interior frames where shown on drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvanized to 'A-60' minimum coating weight standard per ASTM-A653 and A924, with coating weight of not less than 0.60 ounce per square foot (0.30 ounce per square foot per side).

#### **2.3 FRAME FABRICATION**

- A. Minimum Gauges:
  1. Interior Openings:
    - a. Less than 4 feet-0 inches in Width: 16 gauge.
    - b. 4 feet-0 inches in Width and greater: 14 gauge.
  2. Exterior Openings: 14 gauge

B. Design and Construction:

1. Frames shall be custom made, knockdown (KD) units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90 degree walls shall have at least four (4) inch wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4 inch at 4 inch CMU, 6-3/4 inch at 6 inch CMU, and 8-3/4 inch at 8 inch CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch head member.
2. Frames shall be strong and rigid, neat in appearance, square, true and free of defects, warp and buckle. Molded members shall be clean cut, straight and of uniform profile throughout their length.
3. Jamb depths, trim, profile and backbends shall be as shown on approved shop drawings.
4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth.
5. Minimum depth of stops shall be 5/8 inch, except at fire windows where minimum depth of stops shall be 3/4 inch.
6. Frames for multiple openings shall have mullion and rail members which are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be knockdown and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to Owner's Best system.
7. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
9. Provide countersunk flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
10. Provide A60 Galvannealed coating at frames in restrooms and locker rooms with showers/Jacuzzi, clean areas such as kitchen rooms.
11. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic locks as noted in door hardware sets in Division 8 Finish Hardware.
  - a. Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations for all exterior locations regardless of electrical hardware specified in Division 8 Finish Hardware.
  - b. Provide electrical knock out boxes with 3/4-inch knockouts.
  - c. Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
  - d. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 8 Finish Hardware.
  - e. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
  - f. Provide field installed conduit per Division 28 section for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8 Finish Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.

12. Hardware Reinforcements:
    - a. Frames shall be mortised, reinforced, drilled and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
    - b. Minimum thickness of hardware reinforcing plates shall be as follows:
      - 1) Hinge and pivot reinforcements (1-1/4 inch x 10 inch minimum size): 7 gauge.
      - 2) Strike reinforcements: 12 gauge.
      - 3) Flush bolt reinforcements: 12 gauge.
      - 4) Closer reinforcements: 12 gauge.
      - 5) Reinforcements for surface-mounted hardware, hold-open arms, surface panic devices: 12 gauge.
  13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.
  14. Jamb Anchors:
    - a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-Strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
      - 1) Frames up to 7 feet-6 inch height - Three (3) anchors
      - 2) Frames 7 feet-6 inch to 8 feet-0 inch height - Four (4) anchors
      - 3) Frames over 8 feet-0 inch height - One (1) anchor for each 2 feet or fraction thereof in height.
    - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16 gauge thickness, securely inside each jamb as follows:
      - 1) Frames up to 7 feet-6 inch height - Four (4) anchors
      - 2) Frames 7 feet-6 inch to 8 feet-0 inch height - Five (5) anchors
      - 3) Frames over 8 feet-0 inch height - Four (4) anchors plus one (1) additional for each 2 feet or fraction thereof over 8 feet-0 inches.
    - c. Frames to be anchored to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
  15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. Eight (8) inch CMU walls with face brick shall have dual offset jamb anchors.
  16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
  17. Loose Glazing Stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
  18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch.
- C. Frame Color: Field painted under Section 09 90 00 to match face of door.

## 2.4 DOOR FABRICATION

- A. Minimum Gauges:
  1. Interior

2. Doors: 0.047 inch or 18 gauge (16 gauge for high frequency doors).
  2. Exterior Doors: 0.059 inch or 16 gauge (14 gauge for windstorm rated doors).
- B. Design and Construction:
1. Types: Doors shall be custom fabricated, of types and sizes shown on approved shop drawings, and shall be seamless face construction with no visible seams or joints on vertical edges with fully welded seams free from blemishes and defects. Thickness: Shall be 1-3/4 inch, unless specifically noted or shown otherwise.
  2. Exterior Doors: Provide doors with 22 gage steel z-channels placed at 6 inches apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
  3. Fabrication:
    - a. Doors shall be strong, rigid and neat in appearance, free from warpage and buckle.
    - b. Corner bends shall be true and straight and of minimum radius for gage of metal used.
    - c. Provide 22 gauge steel stiffeners spaced maximum six (6) inches on center and extending full height of door.
    - d. Fill interior with noncombustible fiberglass insulation. Use mineral board filler as required for labeled doors.
    - e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled and dressed smooth to provide a smooth flush surface.
    - f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
    - g. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Division 8 Finish Hardware.
    - h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8 Finish Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
    - i. Doors within in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
    - j. Edge profile shall be provided on both vertical edges of door as follows:
      - 1) Single-Acting Swing Doors: Beveled 1/8 inch in 2 inches.
  - k. Hardware Reinforcements:
    - 1) Doors shall be mortised, reinforced, drilled and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
    - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
      - a) Hinge & pivot reinforcements: 7 gauge
      - b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
  4. Glass Moldings and Stops: Loose stops shall be not less than 20 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
  5. Louvers: Shall be inverted "V" blade, sightproof type, unless noted otherwise.

6. Edge Clearances:
  - a. Between Door and Frame at Head and Jambs: 1/8 inch.
  - b. At DoorSills with No Threshold: 5/8 inch to 3/4 inch above finished floor.
  - c. At DoorSills with Threshold: As required to suit threshold.
  - d. Between Meeting Edges of Double Doors: 1/8 inch.
- C. Finish:
  1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
    - a. Clean surfaces free of mill scale, rust, oil, grease, dirt and other foreign matter.
    - b. Chemically treat surfaces and apply one (1) coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.
  2. Field painted under Section 09 90 00.

## 2.5 LABELED DOORS AND FRAMES

- A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.
- B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware or other reason; the Architect shall be so advised before fabrication work on that item is started.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Separate dissimilar metals. Protect against galvanic action.
- B. Frames:
  1. Anchorage and Connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180 degree door swing.
  2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
  3. Frame Spreader Bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
  4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled frames.
- C. Doors:
  1. Install hardware in accordance with hardware manufacturer's templates and instructions.
  2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
  3. Adjust operable parts for correct function.
  4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

### 3.2 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.

- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

**END OF SECTION 08 11 13**



## **SECTION 08 11 16 - ALUMINUM DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Prefinished aluminum doors and frames for interior use.
  - 2. Accessories necessary for a complete installation.

#### **1.3 RELATED SECTIONS**

- A. Section 04 20 00 – Unit Masonry.
- B. Section 05 50 00 – Metal Fabrications.
- C. Section 06 10 00 – Rought Carpentry.
- D. Section 07 92 00 – Joint Sealants.
- E. Section 08 71 00 – Door Hardware.
- F. Section 08 80 00 – Glazing.
- G. Section 09 90 00 – Paintings and Coating.

#### **1.4 REFERENCES**

- A. American Architectural Manufacturers Association (AAMA)
  - 1. AAMA 609/610, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
- B. American Society for Testing and Materials International, (ASTM).
  - 1. ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Fire Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire protection ratings and temperature rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke and Draft Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
  - 2. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire rated door assemblies except for size.
    - a. Temperature Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450

degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.

- B. Fire Rated, Borrowed Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than .40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) when tested according to ASTM C 518.
- D. Wind Loads: Provide hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding windload design pressures which are calculated for this project by a registered Architect or Engineer and is part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction and the International Building Code Design Loads per section 1609.
- E. Hurricane-Resistance Test Performance: Provide hollow metal and door hardware approved assemblies that pass large missile-impact tests, as required by Texas Department of Insurance systems location above grade, and cyclic-pressure tests according to testing requirements of authorities having jurisdiction.
  - 1. Impact Resistance: Hollow metal with approved door hardware assemblies must satisfy the Texas Department of Insurance's criteria for protection from windborne debris in both the Inland 1 zone and the Seaward zone. The assemblies must have passed the large missile impact test (which equates to Missile Level D specified in ASTM E 1996-02). The assemblies may be installed at any height on the structure as long as the design pressure rating for the assemblies is not exceeded. These assemblies will and do not need to be protected with an impact protective system when installed in areas where windborne debris protection is required.

## 1.6 SUBMITTALS

- A. Product Data: Technical data for each product indicated, including material descriptions, core descriptions, label compliance, sound and fire resistance ratings, temperature rise ratings and finishes for each type of door and frame specified.
- B. Shop Drawings: Submit door and frame schedule using same reference designations indicated on Drawings.
  - 1. Include opening size(s), handing of doors, frame throat dimensions, details of each frame type, elevations of door design types, details of door and frame construction including vertical and horizontal edge details and metal thickness, location and installation requirements of door hardware and reinforcements, hardware group numbers, details of anchorage, joint, field splice, and connections, details of moldings, removable stops, and glazing, elevations and profiles, fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.
  - 2. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices, signals, and control systems.
- C. Samples: Submit:
  - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
  - 2. Prepare Samples approximately 12 inch by 12 inch (305 by 305 mm) [8 inch by 10 inch (203 by 254 mm)] to demonstrate compliance with requirements for quality of materials and construction:
    - a. Doors: Show vertical edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.

- b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed steel panels and glazing if applicable.
- D. Schedule: Provide a schedule of steel door and frames prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.
- E. Product Test Reports: For each type of steel door and frame assembly, for tests performed by a qualified testing agency.
- F. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for fire rated door assemblies, smoke and draft control door assemblies, and temperature rise rated door assemblies.
  - 1. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

## 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with applicable requirements of the IBC for steel doors and frames.
  - 2. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
  - 3. Steel Door and Frame Standard: Comply with applicable provisions of Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM):
    - a. HMMA *Hollow Metal Manual*.
    - b. HMMA 861 *Guide Specifications for Commercial Hollow Metal Doors and Frames*.
  - 4. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252. Provide metal labels permanently fastened on each door and frame assembly within size limitations established by the labeling authority having jurisdiction.
    - a. Positive Pressure Rated Door Assemblies: Where indicated provide positive pressure rated fire rated door assemblies. Sizes and configurations as shown on the Drawings. Installed door assemblies shall be in accordance with door manufacturer's certified assemblies.
      - 1) Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1000 mm) or less above the sill.
  - 5. Smoke Control Door Assemblies: Comply with NFPA 105 or UL 1784.
  - 6. Fire Rated, Borrowed Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- B. Manufacturer Qualifications: Firm having minimum five (5) years documented experience in manufacturing steel doors and frames, with sufficient production capacity to produce required units.
- C. Source Limitations: Obtain steel doors and frames from single source from single manufacturer.

- D. Preinstallation Conference: Conduct conference at site.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and site storage. Do not use nonvented plastic. Provide additional protection to prevent damage to factory finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work vertically under cover at site with head up. Place on minimum 4 inch (102 mm) high wood blocking. Provide minimum 1/4 inch (6 mm) space between each stacked door to permit air circulation.
- D. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces is not acceptable. Remove and replace damaged items directed by Owner. Store doors and frames at building site in dry location and off ground to prevent deterioration.

### **1.9 COORDINATION**

- A. Coordinate anchorage installation for steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

### **1.10 WARRANTY**

- A. Provide a written warranty for work of this section from manufacturer for failure due to defective materials and from contractor for failure due to defective workmanship for ten (10) years respectively from the date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 DOOR AND FRAMES MATERIALS**

- A. Basis of Design Manufacturers: Versatrac; (713) 681-8047. Other manufacturers are subject to compliance with requirements.
- B. Aluminum: Controlled alloy billets of 6063 T5, to assure compliance with tight dimensional tolerances and maintain color uniformity.

### **2.2 DOORS**

- A. Aluminum Doors:
  - 1. Wide stile: Provide doors with the following characteristics:
    - a. 1-3/4 inch thickness.
    - b. 5-1/2 inch beveled stiles.
    - c. 4-1/4 inch or 6-1/2 inch top rails.
    - d. 4-1/4 inch, 6-1/2 inch or 10-1/2 inch bottom rails.
    - e. 1-1/2 inch muntin bars.
  - 2. Glazing: Refer to 08 80 00- Glazing specification: 6 mm transparent, tempered glass.

- B. Hardware Reinforcement: ANSI/NAAMM-HMMA 861; fabricate reinforcing from the same material as door to comply with requirements. Offset reinforcement so that faces of mortised hardware items are flush with door surfaces.
  - 1. Hinges and Pivots: 0.167 inch (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 9 inches (229 mm).
  - 2. Lock Front, Strike, and Flushbolt Reinforcements: 0.093 inch (2.3 mm) thick by size as required by hardware manufacturer.
  - 3. Lock Reinforcement Units: 0.067 inch (1.7 mm) thick by size as required by hardware manufacturer.
  - 4. Closer Reinforcements: 0.093 inch (2.3 mm) thick one piece channel by size as required by hardware manufacturer.
  - 5. Other Hardware Reinforcements: Required for adequate strength and anchorage; in lieu of reinforcement specified, hardware manufacturers recommended reinforcing units may be used.
  - 6. Exit Device Reinforcements: 0.250 inch (6.35 mm) thick by 10 inches (245 mm) high by 4 inches (101 mm) wide centered on exit device case body, unless otherwise recommended by exit device manufacturer.
- C. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.
  - 1. Provide cutouts and reinforcements required for doors and frames to accept security system components.
  - 2. Doors with Electric Hinges and Pivots: Provide with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.
    - a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

## **2.3 DOOR FABRICATION**

- A. Pre-machine doors and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required.
- B. Provide welded corners with internal concealed corner clips for strength. Remove tool marks and surface imperfections; dress smooth exposed faces of welded joints. Use of metallic filler to conceal manufacturing defects is not acceptable.
- C. Vertical stiles and horizontal rails to have tight joints. Allow for 1/32" gap on each end of glass stops to allow installation without damage to the doors finish.

## **2.4 DOOR FINISHES**

- A. Factory finish extruded frame components so that any part exposed to view upon completion of installation will be uniform in finish and color.

## **2.5 DOOR FRAMES**

- A. Extruded Aluminum Frames:
  - 1. Freestanding Frames; ceiling height or less than ceiling height system not using a continuous head track.
  - 2. Face Profile: 1-1/2 inches.
  - 3. Return: 9/32 inch.
  - 4. Throat Size: 4-7/8 inches (487 Series), or as indicated by wall thicknesses on the drawings.
- B. Wall Top Tracks and End Caps: match frame dimensions and finish.

- C. Hardware Reinforcement: Fabricate reinforcements from same material as frame. Offset reinforcement so faces of mortised hardware items are flush with surface of the frame.
  - 1. Hinges and Pivots: 0.167 inch (4.2 mm) thick by 1-1/4 inches (32 mm) wide by 10 inches (254 mm).
  - 2. Strike, Surface Mounted Hold Open Arms, and Flushbolt Reinforcements: 0.093 inch (2.3 mm) thick by size as required by hardware manufacturer.
  - 3. Closer Reinforcements: 0.093 inch (2.3 mm) thick one piece channel by size as required by hardware manufacturer.
  - 4. Other Hardware Reinforcements: As required for adequate strength and anchorage.
  
- B. Electrical Requirements: Make provisions for installation of electrical items; provide cutouts so wiring can be readily removed and replaced.
  - 1. Provide cutouts and reinforcements required for steel frames to accept security system components.
  - 2. Frames with Electric Hinges and Pivots: Provide welded on UL listed back boxes with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.
    - a. Hinge Location: Center for doors less than 90 inches (2286 mm) tall or second hinge from door bottom for doors greater than 90 inches (2286 mm); top or bottom electric hinge locations shall not be permitted.

## **2.6 STOPS, MOLDINGS, AND PANELS**

- A. Stops and Moldings: Stops and moldings around glazed lites and louvers where indicated.
  - 1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 2. Provide loose stops and moldings on inside of steel door and frame work.
  - 3. Provide stops and moldings formed of 0.032 inch (0.8mm) thick steel sheets matching steel frames. Secure with countersunk oval head machine screws spaced uniformly not more than 12 inches (300 mm) o.c. Form corners with butted hairline joints.
  - 4. Coordinate rabbet width between fixed and removable stops with type of glass or panel and type of installation indicated.
  
- B. Borrowed Lites: Steel frames of metallic coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), full profile welded.

## **2.7 FRAME FABRICATION**

- A. Pre-machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within frame with concealed screws.
  
- B. Provide corner reinforcements and alignment clips as needed for precise butt connections.
  
- C. Fabricate all components to allow secure installation without exposed fasteners.

## **2.8 FRAME FINISHES**

- A. Factory finish extruded frame components so that any part exposed to view upon completion of installation will be uniform in finish and color.
  
- B. Factory Applied Paint Finish: Comply with AAMA (2603) 603.8 and AA-DAF-45, factory applied backed enamel coating in color to match existing, or as selected by Architect from manufacturer's available colors.
  
- C. Anodized: Clear 215 R1, AA-M10C12C22A41, Class II, 0.4 mils thick.

## **2.9 Labeled Assemblies**

- A. Assemblies: ASTM E 152, tested and listed by Underwriters Laboratories, bearing appropriate label.
- B. Labeled Doors: Tested and listed by Underwriters Laboratories bearing appropriate label. Provide astragal at pairs of doors and at double egress doors.
  - 1. 20 Minute Labeled Doors (Corridor Partitions and Smoke Barrier partitions): ASTM E 152 without hose stream and bearing UL label or approved label by an independent testing laboratory.
  - 2. Swing Label Doors: Meet label requirements permitting single point UL approved latches.
  - 3. Pairs with Open Back Strike Hardware: Tested and labeled for use.
  - 4. Stairway Enclosures: Where fire doors are used in stairway enclosures, construct doors for maximum transmitted temperature end point not to exceed 450 degrees F. above ambient at the end of 30 minutes of the Standard Fire Exposure Test.
- C. Labeling: Provide label bearing name of manufacturer and testing laboratory; rating; permanently affixed or label type self-destructing if removed. Provide labels controlled by testing laboratory and factory installed. Placed labels at hinge edge readily available to inspection agencies.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine project conditions and verify that the Work of this Section may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify wall thickness does not exceed standard tolerances allowed by specified throat size.

### **3.2 PREPARATION**

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### **3.3 INSTALLATION**

- A. Comply with frame manufacturer's printed installation instructions and approved shop drawings. Do not attempt installation in areas where wall thickness exceeds throat size specified.
- B. Install frames plumb and square, securely anchored to substrates with fasteners recommended by frame manufacturer.
- C. Set all framing in correct locations as shown on the drawings, level, square, plumb and in alignment with other work in accordance with the manufacturer's installation instructions and approved shop drawings.
- D. Hardware: Apply hardware in accordance with hardware manufacturer's instructions and Section 08 71 00. Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.
- E. Glazing: Install glazing in door opening in accordance with Section 08 80 00, glazing manufacturer's written instructions, and with UL for fire rated assemblies.

1. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

### **3.4 PROTECTION**

- A. Provide protection required to assure that frames will be without damage or deterioration upon Substantial Completion of the Project.

### **3.5 ADJUSTING AND CLEANING**

- A. Final Adjustments: Verify and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including steel door and frame work that is warped, bowed, or unacceptable.
- B. Touch up marred areas so that touch-up is not visible from a distance of four (4) feet. Remove and replace frames that cannot be satisfactorily adjusted.
- C. Prime Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air drying, rust inhibitive primer. Refer to Section 099000 for field painting of ferrous metals. Spray apply primer; do not brush.
- D. Metallic Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Refer to Section 09 90 00 for cleaning and touchup painting of abraded areas of paint.

**END OF SECTION 08 11 16**



## **SECTION 08 14 16 - FLUSH WOOD DOORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 RELATED SECTIONS**

- A. Section 06 20 00 - Finish Carpentry and Millwork: Installation of doors and finish hardware.
- B. Section 08 11 13 - Hollow Metal Doors and Frames: Door frames.
- C. Section 08 71 00 - Door Hardware.
- D. Section 08 80 00 - Glazed Systems: Vision glass types for factory glazing.

#### **1.2 REFERENCES**

- A. ASTM International (ASTM)
  - 1. E2074, Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
- B. Architectural Woodwork Institute (AWI)
  - 1. Veneer Quality Standards
- C. Commercial Standard (CS)
  - 1. 236
- D. National Fire Protection Association (NFPA)
  - 1. 80, Fire Doors and Windows
  - 2. 252, Standard Method of Fire Tests for Door Assemblies
- E. Underwriters Laboratories (UL)
  - 1. 10 (c), Fire Tests of Door Assemblies - Positive Pressure
  - 2. Listings for Fire Doors
- F. Wood Door and Window Manufacturers Association (WDMA) I.S. 1A Flush Wood Door Performance Standards.
- G. Intertek Testing, Services (Warnock Hersey, Inc. (WHI)
  - 1. Certification Listings for Fire Doors

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings:

1. Show or schedule location, size, thickness, elevation, details of construction, location and extent of hardware blocking, fire rating, finish requirements and other pertinent data for each door required.
2. Include schedule of hardware preparation required for each door.
3. Indicate requirements for veneer matching.

C. Samples:

1. Factory finishes applied to actual door face material, approximately 8 inch by 10 inches, for each material and finish for Architect's selection and approval. For each wood species and transparent finish, provide set of three (3) samples showing typical color range of color and grain to be expected in the finished work. Approved sample will be basis for which all finish work is judged.
2. Corner sections of doors, manufacturer's standard size with door face and edgings representing typical construction. Finish sample with specified veneer demonstrating the range of color and grain for species of veneer and solid lumber required.

#### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with AWI Quality Standards, Custom Grade A.
- B. Comply with WDMA I.S. 1-A, 2004 Edition "Industry Standard for Architectural Wood Flush Doors" and exceed Extra Heavy Duty performance standards.
- C. Fire Rated Door Construction:
  1. Conform to ASTM E2074, NFPA 252, or UL 10 (c) as applicable and as required by code authorities having jurisdiction.
  2. Fire doors shall bear labels, permanently attached to the hinge stile or to top rail that:
    - a. Allows label to be visible when door is open.
    - b. Are approved by and shows testing laboratory approval for classification specified, scheduled or required. The testing laboratory shall be UL or WHI.
- D. Fire Rated Door Installation:
  1. Conform to NFPA 80 and as required by code authorities having jurisdiction.

#### 1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver to site, store, protect, and handle doors in accordance with AWI Quality Standards and manufacturer's instructions. Accept doors on site in manufacturer's standard packaging. HVAC systems shall be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25 percent or greater than 55 percent.
- B. Storage:
  1. Store doors in a clean and dry location protected from weather and abuse.
  2. Stabilize moisture content prior to installation.
- C. Wear clean white cotton gloves when handling factory finished doors.
- D. Mark each door on the top or in the top hinge with opening numbers corresponding to approved shop drawings.

#### 1.7 WARRANTY

- A. Provide for lifetime replacing, including cost of rehangng and refinishing, at no cost to Owner, wood doors exhibiting defects in materials or workmanship including, but not limited to the following:
1. Warp in excess of 1/4 inch as defined by AWI.
  2. Warp or twist to a degree that door will not operate properly.
  3. Delamination of face veneers.
  4. Telegraphing or show through of stiles, rails, or core greater than 0.01 inch in any 3 inch area.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers listed or named in the specifications that produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
1. Algoma Hardwoods, Inc.
  2. Eggers Industries
  3. Graham Manufacturing Corp.
  4. Haley Brothers Inc.
  5. Masonite Architectural Company.
  6. Oshkosh Architectural Door Company
  7. VT Industries, Inc.

### **2.2 MATERIALS**

- A. Flush Interior Non-Rated Wood Doors:
1. General: 5-ply, hot-pressed, AWI PC-5 Veneer, Bonded Particle Core, stile and rails abrasively planed as an assembly prior to veneering, factory machine and fit.
  2. Thickness: 1-3/4 inch.
  3. Core: 32 lbs per cubic foot particleboard, 1LD2 in accordance with ANSI A208.1
    - a. Furnish Structural Lumber Core:
      - 1) At doors with more than 40 percent of door core removed due to light or vent cutouts.
      - 2) At doors with exit devices.
  4. Stile: LSL, 1-3/8 inch, bonded to core
  5. Rail: LSL, bonded to core, 1-1/8 inch minimum, 5 inch head rail for closer reinforcement.
  6. Facing: Select white birch veneer , rotary cut, Custom A grade, book match, center balance
  7. Finish: TR-6, clear, UV protected, factory finish as selected by Architect.
  8. Pair and Set Match: Provide at doors hung in same opening or separated only by mullions
  9. Transom match: continuous match, as occurs
  10. Door Edges: All door edges (1-3/4 inch face) shall be wood veneer or stained to match door face as selected by the Architect. Provide factory-applied sealer at top and bottom edge of doors and cut surface of openings.
- B. Flush Interior Fire Rated Wood Doors:
1. Meet applicable requirements of Paragraph A above.
  2. Doors scheduled to be fire-rated shall receive the appropriate label. Schedule and conform to labeling requirements of code authorities having jurisdiction over this work.
    - a. Core: 20 minute fire-rated, 1LD2 particleboard, positive pressure Category A. Comply with commercial standard CS 236 and AWI, furnish Structural Lumber Core at doors with more than 40 percent of door core removed dur to light or vent cutouts, and at doors with exit devices.

- C. Mineral Core:
  - 1. Meet applicable requirements of Paragraph A above.
  - 2. Doors scheduled to be fire-rated shall receive the appropriate label. Schedule and conform to labeling requirements of code authorities having jurisdiction over this work
  - 3. Core: asbestos-free, incombustible mineral sections - 45, 60, or 90 minute fire-rated, positive pressure Category A.
  - 4. Blocking:
    - a. 5-inch top-rail blocking, in doors indicated to have closers.
    - b. 5-inch bottom-rail blocking, in doors indicating armor plates.
    - c. 5-inch mid-rail and corner blocking, in doors indicated to have exit devices.
  - 5. Stiles and Rails: Manufacturers thickness to achieve rating.
  - 6. Fire rating: as scheduled on drawings.
- D. Face:
  - 1. PL-1: Plastic Lamanite.
    - a. Chestnut Woodline 5884-58.
    - b. Wild Cherry 7054-60.
    - c. Edge: Plam.
- E. Accessories:
  - 1. Glazing: Factory glaze with glass as indicated. Verify compatibility of glazing system with positive pressure requirements where applicable.
  - 2. Glazing Stops (Where shown): Wood, of same species as door facing. Wood with metal clips for rated doors or rolled steel where required for fire rating prepared for countersink style tamper proof screws. Size for 6 inch by 36 inch vision glass, unless noted otherwise.
  - 3. Adhesive: Type 1
- F. Fabrication:
  - 1. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
  - 2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  - 3. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
  - 4. Doors with mortised hinges to be furnished per-drill pilot holes for hinge screws.
  - 5. Electrical Wiring: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 8 "Finish Hardware".

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Doors and hardware installed under Section 06 20 00, Finish Carpentry and Millwork. Follow manufacturer's printed instructions. Coordinate work with door opening construction, and door and frame hardware installation.
- B. Clearances:
  - 1. Head and Jambs, meeting edges: 1/8 inch maximum.
  - 2. Sill: 1/2 inch typically, except provide 1/4 inch clearance from top surface of carpeting.

- C. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and that the frames are installed plumb, level and parallel. Reject doors with defects that are not repairable.
- D. Coordinate hardware installation for proper door operation. Adjust locks and latches to engage snugly without forcing. Align hardware to function without squeaking, binding, or racking. Mortise as required for automatic door bottoms.
- E. Protect doors from damage and replace doors that are damaged. Verify that tops and bottoms of doors have been sealed prior to installation, as required for warranty.
- F. Interior Fire Rated Wood Doors installed where scheduled.
  - 1. Conform to NFPA 80, UL, and requirements of code authorities having jurisdiction.
  - 2. Do not trim positive pressure rated doors.

### **3.2 CLEANING AND REPAIRING**

- A. Clean doors in accordance with manufacturer's instructions.
- B. Touch-up damaged finishes to match undamaged finish in accordance with manufacturer's instructions.
- C. Repair or replace damaged doors at no expense to Owner.

**END OF SECTION 08 14 16**

## **SECTION 08 17 13 - INTEGRATED METAL DOOR OPENING ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.01 GENERAL REQUIREMENTS**

- A. The General Conditions, Supplementary General Conditions, and Division 1 - General Requirements are hereby made a part of this Section as fully as if repeated herein.

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Integrated metal door opening assemblies with doors, operating hardware, accessories, and installation for a complete assembly.

#### **1.03 REFERENCES**

- A. ANSI/BHMA A156.32 – Integrated Door Opening Assemblies, 2015.
- B. ANSI/UL 10C -- Positive Pressure Fire Tests of Door Assemblies, American National Standards Institute/Underwriters Laboratories, 2001.
- C. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, American Society of Testing and Materials; 2004a.
- D. AWI AWQS - Architectural Woodwork Quality Standards P-208; The Architectural Woodwork Institute; 8th Edition.
- E. NFPA 101 – Life Safety Code, National Fire Protection Association, 2003.
- F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies, National Fire Protection Association, 2003.
- G. SDI 111 A - Recommended Steel Door Frame Details, Steel Door Institute; 2002.
- H. SDI 112 - Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames, Steel Door Institute, 1997.
- I. UL 1784 – Air Leakage Tests for Door Assemblies without an artificial bottom seal, Underwriters Laboratories Inc., 2001 (For Smoke Containment, Enclosed Elevator Lobbies, Fire Service Access Elevator Lobby Doors, Hoistway Opening Protection)

#### **1.04 SYSTEM DESCRIPTION**

- A. Performance Requirements:
  - 1. Certified to BHMA – A156.32, Integrated Door Opening Assemblies, 2015.

#### **1.05 SUBMITTALS**

- A. Shop Drawings
  - 1. Indicate each door and frame condition; frame type, profile and installation detail; items of finish hardware, finishes and electrical rough-in requirements.

- B. Samples
  - 1. In accordance with Section 01 33 00.
- C. Environmental
  - 1. Submit UL certification for Environmental Product Declaration (EPD).
- D. Performance
  - 1. Submit certification for ANSI/BHMA 156.32.

#### **1.06 QUALITY ASSURANCE**

- A. Qualifications
  - 1. Manufacturer: Firm with not less than 5 years successful experience in fabrication of integrated metal door opening assemblies with full-height latch/lock and full-height hinge.
  - 2. Supplier: Authorized distributor of manufacturer.
  - 3. Installer: Manufacturer certified.
- B. Regulatory Requirements
  - 1. Rated door assemblies shall have been tested to meet conditions of NFPA 252 as required by NFPA 101 section 6-2.3.3.

#### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Packaging: Polyvinyl wrapped, palette by floor, and clearly marked for each opening.
- B. Delivery: Deliver to site in original unopened containers and pallets bearing system manufacturers name, and brand.
- C. Store: Horizontally on level surface, not less than 2 inches off floor in a clean, dry well-ventilated area protected from sunlight, extreme heat, dryness and moisture.
- D. Receiving, off-loading, and site distribution should be handled by an authorized Total Door Distributor unless otherwise stipulated by contract. If the G.C. or other entity handles all or any portion of the receiving, off-loading, and site distribution, they are held responsible for any and all damages that may result from potential miss handling of the product.

#### **1.08 PROJECT CONDITIONS**

- A. Do not bring door systems to site until building temperature and humidity ranges are compatible with recommended values for preservation of wood moisture content as listed by AWI AWQS. Building shall be stabilized at 30 to 60 percent humidity.

#### **1.09 WARRANTY**

- A. Integrated metal door opening assembly: Manufacturer's standard 5 year warranty against defects in material and workmanship. Refer to Manufacturer's published warranty.
- B. Store doors in a clear, dry ventilated space having controlled temperature and a relative humidity range between 30 and 60 percent. Stack doors flat and off the floor to prevent warpage.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Integrated metal door systems

1. Total Door: [www.totaldoor.com](http://www.totaldoor.com) or comparable product approved by Architect.
- B. Hardware
1. Total Door: [www.totaldoor.com](http://www.totaldoor.com) or comparable product approved by Architect.

## 2.02 MATERIALS

- A. Frames
1. To be supplied by others.
  2. In accordance with ANSI/SDI A250.8, SDI 111A, and SDI 112.
  3. Construction: KD or All-welded units.
  4. Material: Steel, cold rolled, ASTM A1008, 16 gauge.
  5. Fire Resistance Rating: Where indicated in Contract Documents for doors.
  6. Spreader Bar: Removable, at sill (For all welded type).
- B. Frame Anchorage Devices
1. To securely fasten to wall construction without distortion or stress.
  2. In accordance with fire resistance rating indicated in Contract Documents.
- C. Integrated Door Assembly
1. Integrated Door Assembly
    - a. Stiles: Steel, galvanized, 16-gauge, spot welded.
    - b. Top and Bottom Rails: 5-1/2 inch 18 gauge steel rails.
    - c. Cores:
      - 1) Solid polystyrene continuously bonded to faces.
      - 2) Temperature Rise.
    - d. Thickness: 1-3/4 inches.
    - e. Faces: Steel, stretcher leveled, without seams or spot welds, galvanized 20 gauge.
    - f. Weld pattern: In accordance with manufacturer's standard details.
  2. Gasketing
    - a. Door System: Factory applied to locking channel
    - b. Frame: Factory supplied, field apply to head of frame.
    - c. Floor: Factory supplied Surface Smoke Seal to be field applied. (must be ordered with elevator shaft & lobby applications)

## 2.03 FINISHES

- A. Hinge and Locking Channel
1. Finish: Factory Pre-Finished.
    - a. Color to be selected by Architect from manufacturer's full range of colors.
- B. Door Faces, Interior
1. Finish: To be selected by Architect from manufacturer's full range of colors, refer to door schedule.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Field Conditions
1. Prior to commencing installation, examine parts of building structure, which are to receive door systems and component parts.
  2. Report, in writing, conditions which would prevent proper execution or endanger permanency of the work to the Architect.
- B. Field Dimensions



1. Where possible, verify frame tolerances before fabrication of door systems.
  2. Notify Architect of variances with reviewed shop drawings.
- C. Corrective measures, when necessary, shall be determined and approved prior to commencing fabrication.
- D. Coordinate door opening assembly details with adjacent work to assure proper attachments, clean junctions, etc.

**3.02 INSTALLATION**

- A. Install work in accordance with Contract Documents and reviewed shop drawings.
1. Install door systems and hardware in accordance with manufacturer's recommendations.
  2. Installer: Manufacturer certified.
- B. Frames: Installed by others
1. Set plumb and square in accordance with DHI standards.
    - a. Out-of-square at frame head: Not to exceed 1/16 inch.
    - b. Out-of-plumb for each frame jamb: Not to exceed 1/16 inch.
    - c. Out-of-alignment for each side in plan: Not to exceed 1/16 inch.
    - d. Twist dimension: Not to exceed 1/16 inch.
  2. Brace until adjacent wall is constructed.
  3. Securely anchor to adjacent wall.
  4. Furnish and install clips, fastenings, and anchorages and conceal unless otherwise noted.
- C. Integrated Door Assembly
1. Hang to maintain manufacturer's installation tolerances.
  2. Adjust to freely swing without binding, sticking, or sagging, and to eliminate excessive clearances.
- D. Hardware: When installation is otherwise complete, confirm proper operation and function.

**PART 4 - SCHEDULE**

**Set 90/180° Hold Open**

2 ea	Full Height Hinges	H-13 Rigidized (1)	Color TBD	Total Door
2 ea	Full Height Latch Channel	L-11	Color TBD	Total Door
2 ea	Lever 85		628	Total Door
2 ea	Exit Device/insert to match skin	PF200 (Flush Panic)	628	Total Door
1 ea	Closer	TDC96P-2	Alum	Total Door
1 ea	Closer	TDC8907	Alum	Total Door
2 ea	Mag Holder	TDH100		Total Door
2 ea	Positive Pressure label (confirm rating with door schedule)			Total Door

(Stairwells may require a temperature rise rating)

(Elevator lobby doors will require a smoke seal (W62) certified to UL1784 w/out an artificial bottom seal)

**END OF SECTION 08 17 13**

## **SECTION 08 31 13 - ACCESS DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Access doors in gypsum board, masonry partitions, and plaster/stucco soffits, where shown or required.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's literature, including schedules, charts, and illustrations to indicate the performance, fabrication, procedures, product variations, and accessories.
  - 2. Manufacturer's installation instructions.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing access doors meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.
  - 1. The Bilco Company, (
  - 2. Acudor Products, Inc., Cedar Grove, NJ.
  - 3. Babcock-Davis (Cierra Products), Garland, TX.
  - 4. Bar-co, Alfab, Inc., Enterprise, AL.
  - 5. J. L. Industries, Incorporated, Bloomington, MN.
  - 6. Karp Associates, Inc., Maspeth, NY.
  - 7. Larsen's Manufacturing Company, Minneapolis, MN.
  - 8. Milcor LP, Holland, OH.
  - 9. Nystrom Building Products Co. Inc., Minneapolis, MN.
  - 10. The Williams Brothers Corporation of America, Front Royal, VA.
- B. Specifications are based on products of Babcock-Davis, Garland, TX; (888) 412-3726.

#### **2.2 PRODUCTS**

- A. General: The following access panel types are for selection as required whether or not indicated on drawings. The contractor shall evaluate the specific requirements and provide the appropriate system based on the condition, as all types may not be required on the project. The inclusion of any of the listed access panel types does not necessarily imply that the condition exists in the scope of work.
- B. Standard type flush steel door for exterior masonry construction:
  - 1. Size: 2 feet-0 inches x 3 feet-0 inches unless otherwise noted in drawings or specifications.
  - 2. Hinges: Stainless steel concealed continuous piano type hinges.

3. Frames: 6063-T5 extruded aluminum frame. Mill finish
  4. Doors: 20 gauge galvanized steel. Phosphate dipped and prime coated for field painting per Section 09900.
  5. Latch and Lock: Two (2) dual acting handles with exterior lock.
  6. Gasketing: Extruded santoprene
  7. Insulation: 2 inch thick fiberglass
  8. Approved Product: Model "B-XT", or Architect approved equal.
- C. Standard type flush steel door for wallboard and masonry construction:
1. Size: 2 feet-0 inches x 3 feet-0 inches unless otherwise noted in drawings or specifications.
    - a. Provide 12 inch x 12 inch access panels at all motorized overhead coiling doors, grilles, and coiling counter doors that are located within non-removable ceilings for access to motors for repairs and maintenance of electric operators.
  2. Hinges: Concealed continuous piano type hinges.
  3. Finish: Phosphate dipped and prime coated for field painting per Section 09 90 00.
  4. Frames: 16 gauge galvanized steel with 22 gauge galvanized wallboard corner bead
  5. Doors: 14 gauge galvanized steel.
  6. Lock: Flush screw driver operated cam.
  7. Approved Product: Model "B-NW", or Architect approved equal.
- D. Standard type flush stainless steel door for ceramic tile and exposed masonry construction:
1. Size: 8 inch x 8 inch unless otherwise noted in drawings or specifications.
  2. Hinges: Concealed spring button.
  3. Finish: #4 satin polish.
  4. Frames: 16 gauge type 304 stainless steel with 1 inch exposed flange.
  5. Doors: 16 gauge type 304 stainless steel.
  6. Lock: Flush screw driver operated cam
  7. Approved Product: Model "BNT", or Architect approved equal.
- E. Standard type flush steel door for plaster/stucco soffit construction:
1. Size: As shown on the drawings.
  2. Hinges: Concealed continuous piano type hinges.
  3. Finish: Phosphate dipped and prime coated for field painting per Section 09 90 00.
  4. Frames: 16 gauge galvanized steel with 22 gauge galvanized plaster casing bead
  5. Doors: 14 gauge galvanized steel.
  6. Lock: Flush screw driver operated cam.
  7. Approved Product: Model "B-NP", or Architect approved equal.
- F. Fire rated flush steel door for wallboard construction:
1. Listing: UL listed 'B' label up to 1-1/2 hours in walls and Warnock-Hershey listed up to 3 hours in ceilings.
  2. Size: As shown on the drawings.
  3. Hinges: Concealed pin hinge
  4. Finish: Phosphate dipped and prime coated for field painting per Section 09 90 00.
  5. Frames: 16 gauge galvanized steel with 22 gauge galvanized wallboard corner bead
  6. Doors: 20 gauge galvanized steel.
  7. Lock: Knurled knob/key operated latch bolt.
  8. Insulation: 2 inch thick fire rated mineral fiber
  9. Approved Product: Model "B-IW", or Architect approved equal.

- F. Insulated access panel for valve box in exterior brick wall:
  - 1. Size: 12 inches x 12 inches, or as required for application.
  - 2. Door: 0.060 6063-T5 extruded aluminum.
  - 3. Frame: 0.060 6063-T5 extruded aluminum.
  - 4. Hinge: Stainless steel concealed piano hinge.
  - 5. Latch: Hex head cam latch operable with standard allen wrench.
  - 6. Flange: 0.080 6063-T5 extruded aluminum.
  - 7. Finish: Paint grip.
  - 8. Insulation: Two (2) inch thick fiberglass.
  - 9. Gasket: Extruded Sanoprene.
  - 10. Approved Product: Model "B-XT", or Architect approved equal.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Locate and provide panels to the trade that is constructing the material being penetrated.

#### **3.2 LOCATIONS**

- A. Provide where required by code and where needed to service and maintain equipment.
- B. If not shown on the drawings, consult the Architect before locating in finished spaces.

**END OF SECTION 08 31 13**

## **SECTION 08 33 23 - OVERHEAD COILING DOORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Manual, insulated service doors.
  2. Fail-safe open on fire alarm.
  3. Accessories necessary for a complete installation.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  1. Design Wind Load: Indicated on Drawings.
  2. Testing: According to ASTM E 330.
  3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
  4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283].
- D. Curtain R-Value: 5.0 degrees F x h x sq. ft./Btu (0.881 K x sq. m/W).
- E. Windborne Debris Impact Resistance: Provide glazed and impact protective overhead coiling doors that pass missile impact and cyclic pressure tests according to ASTM E 1996 for Wind Zone 2.
  1. Large Missile Test: For overhead coiling doors located within 30 feet (9.144 m) of grade.
  2. Small Missile Test: For overhead coiling doors located more than 30 feet (9.144 m) above grade.
- F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 100,000 cycles for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  1. Include tamperproof cycle counter.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  1. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

2. Include description of automatic closing device and testing and resetting instructions.
- B. Shop Drawings: Submit plans, elevations, sections, and mounting details.
  1. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  5. Show locations of controls and other accessories.
  6. Include diagrams for power, signal, and control wiring.
- C. Samples: Submit samples for exposed metal finish in standard sizes.
- D. Delegated Design Submittal: Submit delegated design including analysis data signed and sealed by the professional engineer licensed in the State of Texas who is responsible for the preparation.
- E. Oversize Construction Certification: For door assemblies required to be fire rated and that exceed size limitations of labeled assemblies.
- F. Maintenance Data: Submit for inclusion in maintenance manuals.

## 1.5 **QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Sound Control Doors: Assemblies tested in a laboratory for sound transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
  3. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS).
- B. Installer Qualifications: Entity having minimum 5 years documented experience who employs installers and supervisors trained and approved by manufacturer for both installation and maintenance of units required.
- C. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  1. Obtain operators and controls from overhead coiling door manufacturer.
- D. A pre-installation meeting is required to be conducted at project site.

## **PART 2 - PRODUCTS**

### **2.1 DOOR ASSEMBLY**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Clopay Building Products.
  - 2. Cookson Company.
  - 3. Cornell Iron Works, Inc.
  - 4. McKeon Door Company, Inc. as distributed by Griesenbeck.
  - 5. Overhead Door Corporation (Manual Doors Only).
  - 6. Wayne-Dalton Corp.
  - 7. Holiday Gate & Door Systems Inc.
- B. Service or Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
- C. Gasket Seal: Continuous gaskets between slats.
- D. Bottom Bar: Two angles, each not less than 1-1/2 inch by 1-1/2 inch by 1/8 inch (38 mm by 38 mm by 3 mm) thick; fabricated from hot dip galvanized steel and finished to match door.
- E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- F. Hood: Match curtain material and finish.
  - 1. Shape: Round.
  - 2. Mounting: Between jambs.
- G. Curtain Accessories: Equip door with smoke seals, weatherseals, astragal, push/pull handles, pull down strap, poll hook and automatic closing device.
- H. Door Finish:
  - 1. Baked Enamel or Powder Coated Finish: Selected by Architect. Exterior doors to be maroon.
  - 2. Factory Prime Finish: Factory Prime Finish: Selected by Architect.

### **2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION**

- A. Door Curtains: Fabricate overhead coiling door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Steel Door Curtain Slats: Zinc coated (galvanized), cold rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
  - 2. Insulation: Fill slats for insulated doors with thermal insulation complying with maximum flame spread and smoke developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
  - 3. Metal Interior Curtain Slat Facing: Match metal of exterior curtain slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- B. Curtain Jamb Guides: Angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment.
  - 1. Tracks to be exposed.

2. Ceiling grid up to both sides at Grille not in gypsum board furrdowns.

### **2.3 HOODS**

- A. Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface mounted hoods and fascia for any portion of between jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  1. Aluminum: 0.040 inch (1.02 mm) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
  2. Exterior Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant joint bead profile for applying joint sealant.

### **2.4 CURTAIN ACCESSORIES**

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather stripping gaskets fitted to entire exterior perimeter of door for weather resistant installation unless otherwise indicated.
  1. At door head, use 1/8 inch (3 mm) thick, replaceable, continuous sheet baffle secured to inside of hood or field installed on the header.
  2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8 inch (3 mm) thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal for Interior Doors: Equip each door bottom bar with replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Push/Pull Handles: Equip each push up operated or emergency operated door with lifting handles on each side of door, finished to match door.
- D. Pull Down Strap: Provide pull down straps for doors more than 84 inches (2130 mm) high.
- E. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

### **2.5 COUNTERBALANCING MECHANISM**

- A. Counterbalance doors using standard mechanism with adjustable tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot formed, structural quality, seamless or welded carbon steel pipe, of sufficient diameter and wall thickness to support rolled up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil tempered, heat treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of cold rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Mounting brackets fabricated from either cast iron or cold rolled steel plate.



## **2.6 MANUAL DOOR OPERATORS**

- A. Equip door with manual door operator by door manufacturer.
- B. Chain Hoist Operator: Consisting of endless steel hand chain, chain pocket wheel and guard, and gear reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy steel hand chain with chain holder secured to operator guide.

## **2.7 FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA *Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)* for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel and Galvanized Steel Finishes:
  - 1. Powder Coat Finish: Baked on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
    - a. Color: Architect to select from manufacturer's full range.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates areas and conditions for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 INSTALLATION**

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Access to items that require service/ replacement should not be blocked by masonry. Conduits. And other MEP systems, etc.
- D. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

### **3.3 STARTUP SERVICE**

- A. Engage a factory authorized service representative to perform startup service.
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

**3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so doors operate easily, free of warp, twist, or distortion. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

**3.5 DEMONSTRATION**

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION 08 33 23**

## **SECTION 08 34 73 - SOUND CONTROL DOOR ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 DESCRIPTION OF WORK**

- A. Provide sound rated door and frame assemblies where shown on the drawings, as specified herein, and as shown on the door schedule.
- B. The work includes door and frame assemblies complete with acoustical seals, hinges, and glazing. Finish hardware shall be as specified elsewhere and shall be provided by the acoustical door manufacturer for a complete factory assembled unit. Except for items specifically listed in this section and finish paint are furnished and installed under other sections of these specifications.

#### **1.3 SUBMITTALS**

- A. For each type of door, provide the following:
  - 1. Schedule of items to be provided under this section.
  - 2. Manufacturer's specifications and other product data needed to demonstrate compliance with these specifications.
  - 3. Shop drawings showing details of each frame type, including profiles, gauges, reinforcing, and anchorage devices for securing to adjacent materials; door types, sizes, swings, hardware and sound seals; operating dimensions, elevations, and cross-sections of doors and sound seals; and cutout details.
  - 4. Certified test reports indicating that the acoustical performance of the door assemblies meets the STC (Sound Transmission Class) performance as called out later in this specification or as shown on the door schedule. Testing shall have been conducted in accordance with ASTM E-90 and rated in accordance with ASTM E-413 by an accredited independent acoustical laboratory that is a member of NVLAP (National Volunteer Laboratory Accreditation Program). Reports shall be submitted on doors and frames identical to the type to be supplied.
  - 5. If required, certify that the assemblies have been tested in accordance with Standard for Safety UL 10b for neutral pressure requirements or Standard for Safety UL10C/UBC7-2 for positive pressure requirements of labeled fire doors and frames, and meet the applicable requirements of NFPA 80.
  - 6. Manufacturer's recommended installation procedures which, when approved by the architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
  - 7. Written guarantee as specified above.

#### **1.4 QUALITY ASSURANCE**

- A. References:
  - 1. ASTM A366: Standard Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
  - 2. ASTM A1011: Standard Specification for Steel, Hot-Rolled Sheet and Strip, Commercial.

3. ASTM A653: Standard Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron alloy Coated (Galvannealed) by the Hot Dipped Process.
  4. ASTM E90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss in Building Partitions.
  5. ASTM E336: Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.
  6. ASTM E413: Classification for Determination of Sound Transmission Class
  7. UL10B: Fire Tests of Door Assemblies.
  8. UL10C: Positive Pressure Fire Tests of Door Assemblies.
  9. UBC7-2: Fire Tests of Door Assemblies.
  10. NFPA 80: Standard for Fire Doors and Fire Windows
  11. HMMA 840: Installation and Storage of Hollow Metal Doors and Frames.
- B. Guarantee all material furnished and installed under this section to be free from defects in material and workmanship for a period of one year from substantial completion of the project.
- C. All work of this section shall be furnished by a single manufacturer experienced in the manufacture of sound rated door and frame assemblies for at least five years.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store steel doors and frames in accordance with requirements of HMMA 840.
- B. Remove wraps or covers from doors and frames upon delivery at the building site; promptly clean and touch-up scratches or disfigurement caused by shipping or handling with rust inhibitive primer. Minor damages may be repaired provided the items are equal in all respects to new work and acceptable to the architect and owner; otherwise, replace damaged items as directed.
- C. Store units on planks or dunnage in a dry location; store doors in a vertical position spaced by blocking.
- D. Store units covered to protect them from damage, but permitting air circulation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with these specifications, the following firms are approved manufacturers of sound rated door and frame assemblies:
1. Clark Door Limited, Carlisle, UK (201) 294-3022.
  2. Industrial Acoustics Company, Bronx, NY (718) 931-8000.
  3. Noise Barriers LLC, Libertyville, IL (847) 843-0500.
  4. Wenger Corporation, Owatonna, MN (507) 455-4100.

### **2.2 MATERIALS, GENERAL**

- A. Sound rated doors and frames to be constructed from formed sheet steel or structural shapes and bars.
- B. Sheet steel shall be commercial quality, level, cold rolled steel conforming to ASTM A-366 or hot rolled, pickled and oiled steel conforming to ASTM A-1011. Exterior units shall be fabricated from galvanized sheet steel conforming to ASTM A-653 / A-653M commercial quality, minimum G60 zinc coating.

- C. Steel shapes shall comply with ASTM A-36 and steel bars with ASTM-108, Grade 1018.

## **2.3 COMPONENTS**

- A. Steel Doors:
  - 1. Sound rated door thickness shall be as required to achieve the specified STC 50 rating.
  - 2. Face gauges, internal sound retardant core, stiffening, and perimeter door edge construction shall be as required to achieve specified acoustical performance. Visible seams on door faces are not permitted.
  - 3. Face sheets shall be joined at vertical edges by continuous welding extending full door height. Grind, fill, and dress welds to provide smooth surface. Visible seams on vertical edges are not permitted.
- B. Frames:
  - 1. Frames shall be 14 gauge minimum split-frame design units and shipped with temporary spreader. Knock-down frames are not acceptable.
  - 2. Corner joints shall have all contact edges closed tight, with trim faces mitered and continuously welded. The use of gussets will not be permitted.
- C. Hardware preparation:
  - 1. Mortise, reinforce, drill, and tap frames at factory for fully templated mortised hardware only, in accordance with approved hardware schedule and supplied templates.
  - 2. Provide reinforcing plates at surface-mounted or non-templated hardware locations.
  - 3. Provide suitable anchors to properly install frames in partition types as shown on architect's drawings.
- D. Door Hardware:
  - 1. Hinges shall be cam-lift type provided in conjunction with fixed door bottom seals. Surface strap or butt hinges, as well as automatic door bottoms, are not acceptable.
  - 2. Hinge, lock, and head of the door shall close against positive neoprene compression and / or magnetic seals mounted in the door frame and / or leaf, as required to meet specified acoustical performance. Combination felt/neoprene seals are not acceptable.
  - 3. Furnish a smooth flush steel threshold; raised sills are not acceptable.
  - 4. Where a double leaf door is specified, an astragal seal shall be provided for the full height of the door, as required to meet the specified acoustical performance.
  - 5. All other hardware shall be as specified elsewhere in Division 08 and supplied / installed by the acoustical door manufacturer.
- E. Painting & Cleaning:
  - 1. After fabrication of doors and frames, all tool marks and surface imperfections shall be removed and exposed faces of all welded joints dressed smooth. Chemically treat all surfaces to insure maximum paint adhesion and coat with a water-based rust-inhibitive primer.
- F. Window Construction:
  - 1. Where vision panels are specified, they shall be identical to a tested assembly as per the door manufacturer that insures the acoustical performance of the door is not degraded.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Door and frame assemblies shall be installed in accordance with approved shop drawings, manufacturer's installation instructions, and these specifications.

- B. Doors shall be installed by manufacturer's trained and authorized installer or contractor trained and approved by the manufacturer.
- C. The manufacturer shall provide factory trained supervisory personnel at the site during the initial frame installation, during initial door installation, and at final inspection. The manufacturer shall issue a letter of compliance certifying the completion of the installation in accordance with these specifications.
- D. Hang doors and adjust for free swinging operation without binding, sticking, sagging or excessive clearances.
- E. All frames shall be packed tightly with loose, lightweight fiberglass during installation.
- F. Caulk joint between frame trim and partition prior to painting.
- G. Install sound control door assemblies during finish phase of construction to protect units from damage.

### **3.2 ADJUST AND CLEAN**

- A. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Check and readjust operating finish hardware items and acoustical seals, leaving doors and frames undamaged and in complete and proper operating condition.

### **3.3 FIELD TESTING VERIFICATION**

- A. If required, the owner will retain the services of an independent acoustical consultant to conduct field sound transmission tests at any designated door locations where acoustical performance is suspected by the architect of not being in compliance with these specifications. The tests shall be conducted in accordance with ASTM E-336 to determine the Field Sound Transmission Class (FSTC) or Noise Isolation Class (NIC), as applicable and feasible. If such results indicate acoustical performance more than 5 points less than the specified STC ratings, it shall be the responsibility of the manufacturer and contractor, at their expense, to correct such deficiencies by methods approved by the architect prior to incorporation. Sound transmission tests shall be repeated and corrective measures implemented until the established performance requirements are met. If the architect determines that the materials are not as specified herein, all costs for the initial tests, as well as costs for retesting, shall be borne by the contractor and manufacturer.

**END OF SECTION 08 34 73**

## **SECTION 08 43 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Exterior and interior storefront framing.
  2. Exterior and interior manual swing entrance doors.
  3. Accessories necessary for a complete installation.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Performance: Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
  1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
  2. Dimensional tolerances of building frame and other adjacent construction.
  3. Failure includes the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.
    - g. Failure of operating units.
- B. Structural Loads:
  1. Wind Loads: Indicated on Drawings.
- C. Deflection of Framing Members:
  1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch19 mm, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch3.2 mm, whichever is smaller.
- D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E 330 as follows:
  1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. 0.03 L/s per sq. m of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 degrees F (67 degrees C, ambient; 180 degrees F 100 degrees C, material surfaces).
  - 2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C).
- H. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- I. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F 3.23 W/sq. m x K when tested according to AAMA 1503.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings: Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other Work.
  - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
  - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- D. Engineer's calculations of performance requirements.
- E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Accessibility Requirements: Comply with applicable requirements.



- a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
  - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- C. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.
- F. Preinstallation Conference: Conduct conference at site.

## **1.6 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

## **1.7 WARRANTY**

- A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration caused by thermal movements.
    - c. Water leakage through fixed glazing and framing areas.
    - d. Failure of operating components.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 10 years from date of Substantial Completion.

## 1.8 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
  - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
  - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Basis of Design: Kawneer Trifab 451/451T (Product Evaluation CWSF-34), impact resistant system, maximum design pressure +/- 45 psf. Subject to compliance with requirements, provide comparable storefront system by one of the following:
  - 1. EFCO Corporation.
  - 2. Old Castle Building Envelope
  - 3. Tubelite, Inc.
  - 4. US Aluminum Corporation.
  - 5. Vistawall.
  - 6. YKK America AP, Inc.
- B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Sheet and Plate: ASTM B 209/ASTM B 209M.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221/ASTM B 221M.
  - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
  - 4. Structural Profiles: ASTM B 308/B 308M.
- C. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
  - 1. Construction: Nonthermal/Thermal.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Center.
- D. Accessories:
  - 1. Brackets and Reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
  - 2. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
    - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
    - b. Reinforce members as required to receive fastener threads.
  - 3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
  - 4. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
  - 5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.

- E. Glazing: Refer to Section 08 80 00 for impact resistant laminated insulating glass with low-e coating on Number 2 surface.
  - 1. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
  - 2. Spacers and Setting Blocks: Elastomeric type.
- F. Windows with head up to 20' AFF as a minimum shall be constructed or unitized factory constructed window systems.
- G. Entrance Doors: Glazed entrance doors for manual swing operation.
  - 1. Basis of Design Manufacturer/Product: 350 Series as manufactured by Kawneer.
  - 2. Door Construction: Extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - 3. Door Design: Wide stile; 3-12 inch (88.9 mm) nominal width.
    - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches 255 mm above floor or ground plane.
  - 4. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.
- H. Entrance Door Hardware: Refer to Section 08 71 00 for aluminum entrance hardware sets.
  - 1. Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
    - a. Opening-Force Requirements:
      - 1) Egress Doors: Maximum than 15 lbf 67 N to release the latch and not more than 30 lbf 133 N to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
      - 2) Accessible Interior Doors: Maximum 5 lbf to fully open door.
    - b. Weather Stripping: Standard replaceable components to match existing.
    - c. Weather Sweeps: Standard exterior door bottom sweep with exposed fasteners on mounting strip to match existing.
- I. Accessories:
  - 1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00.
  - 2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil 0.762 mm thickness per coat.

## 2.2 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members: Fabricate components that, when assembled, have specified characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 6. Provisions for field replacement of glazing from interior for vision glass and exterior for

spandrel glazing or metal panels.

7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Storefront Framing: Fabricate components for assembly using screw spline system.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  1. At exterior doors, provide weather stripping at fixed stops.
  2. At interior doors, provide weather stripping at stops to prevent metal to metal contact.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
  2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- H. Vertical members of storefront and curtain wall trim not to exceed 10 feet in length.

### **2.3 ALUMINUM FINISHES**

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  1. Color: Bronze.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 INSTALLATION**

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
  1. Do not install damaged components.
  2. Fit joints to produce hairline joints free of burrs and distortion.
  3. Rigidly secure nonmovement joints.
  4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
  5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
  1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
  2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members,

and moisture migrating within the system to exterior.

- D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 to produce weathertight installation. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- E. Install glazing specified in Section 08 80 00.
- F. Entrance Doors and Hardware: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field Installed Entrance Door Hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- G. Install perimeter joint sealants as specified in Section 07 92 00 to produce weathertight installation.

### **3.3 ERECTION TOLERANCES**

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
  - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
  - 2. Alignment:
    - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch 1.5 mm.
    - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch 0.8 mm.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch 3 mm.

### **3.4 ADJUSTING**

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
  - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches 75 mm from the latch, measured to the leading door edge.

**END OF SECTION 08 43 13**

## **SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Glazed aluminum curtain walls.
  2. Accessories necessary for a complete installation.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of curtainwalls and aluminum storefronts to design glazed aluminum curtain walls using performance requirements and design criteria indicated.
- B. Provide curtain wall assembly, storefront system, and windows by a single source and tested as a combined single assembly.
- C. System Description: Curtainwall assembly fabricated from aluminum stick framed system with exposed interior and exterior metal framing. Design system to allow for installation tolerances, expansion and contraction of adjacent materials and joint design.
  1. Drawings are diagrammatic and do not identify or solve thermal or structural movement, glazing, anchorage, or moisture disposal. Details establish basic dimension of unit, sight lines, and profiles of members.
  2. Glass, sealants, and interior finishes do not contribute to framing member strength, stiffness, or lateral stability.
  3. Design and fabricate glazing systems for interior glazing.
  4. Design perimeter conditions to allow for installation tolerances, expansion and contraction of adjacent materials, and sealant manufacturer's recommended joint design.
  5. Design attachments to address site conditions, expansion, and contraction movements to eliminate possibility of loosening, weakening, or fracturing connection between units and building structure or between units themselves.
  6. Allow for expansion and contraction due to structural movement without detriment to appearance or performance.
  7. Design system to drain to exterior face of wall, water entering joints and condensation occurring within system by drain holes and gutters of adequate size to evacuate water without infiltration to interior or the top of lower lites of glass.
  8. Design metal faces to be visually flat under lighting conditions.
  9. Design interior dense EPDM wedge gasket with sealed corners, with maximum 30% compression when glazed, to create a water and air seal.
  10. Design rigid isolators to maintain flatness of face caps and provide thermal break between exterior and interior members.
  11. For stresses placed on structural silicone sealants, maintain sealant manufacturer's recommended maximum.
  12. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

- D. Performance Criteria: Coordinate with Section 084100 for performance criteria, fabrication, and erection standards. Provide curtain wall assemblies to meet or exceed performance requirements:
1. Design and fabricate curtain wall to withstand the operating loads without measurable permanent deflection. Limit deflections to provide the normal degree of rigidity required to avoid glass breakage, air infiltration, and objectionable results of excessive flexibility.
  2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  3. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- E. Structural Loads:
1. Wind Loads: Design, fabricate, and install framing system to withstand the maximum inward and outward wind pressures required by IBC.
    - a. Basic Wind Speed: Refer to Structural Drawings.
    - b. Exposure Category: Refer to Structural Drawings.
    - c. Risk Category: Refer to Structural Drawings.
  2. Deflection of Framing Members: At design wind pressure:
    - a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
    - b. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
      - 1.) Operable Units: Provide a minimum 1/16 inch (1.6 mm) clearance between framing members and operable units.
    - c. Cantilever Deflection: Where framing members overhang an anchor point:
      - 1.) Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
    - d. Do not permit permanent deformation (set) in metal framing work. Permanent deformation, fastener, weld, or gasket failure, component breakage or disengagement shall not occur under wind loading equal to 1.5 times the wind loads (positive or negative). Permanent deformation shall be taken as deflection without recovery exceeding 1/1000 times span.
- F. Structural: Test according to ASTM E 330:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

- G. Air Infiltration: Test according to ASTM E 283 for infiltration:
  - 1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) and 6.24 lbf/sq. ft. (300 Pa).
- H. Water Penetration under Static Pressure: Test according to ASTM E 331:
  - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
- I. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1:
  - 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft. (720 Pa).
  - 2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- J. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
  - 1. Design Displacement: Indicated on Drawings.
  - 2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.
- K. Energy Performance: Certify and label energy performance according to NFRC:
  - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) [0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
  - 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
  - 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC certified condensation resistance rating of no less than 25 as determined according to NFRC 500. Excessive condensation is defined as the accumulation of uncontrolled condensate flowing from the curtain wall at any location, or visible ice, frost, or water on more than 5% of the area of any module of the exterior wall.
- L. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332:
  - 1. Outdoor-Indoor Transmission (OITC) Class: Minimum **[26] [30] [34]**.
- M. Sound Transmission: Provide window wall and storefront systems with fixed glazing and framing areas having sound transmission characteristics of:
  - 1. Sound Transmission Class (STC): Minimum 31 standard and 37 laminated STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- N. Blast Resistance:
  - 1. Hazard Rating: Minimal Hazard per ASTM F 1642.
  - 2. Performance Condition: 3b per GSA-TS01.
- O. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
  - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
  - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.



- a. High Exterior Ambient Air Temperature: That which produces an exterior metal surface temperature of 180 degrees F (82 degrees C).
  - b. Low Exterior Ambient Air Temperature: 0 degrees F (minus 18 degrees C).
- P. Structural Sealant Joints:
1. Designed to carry gravity loads of glazing.
  2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).
- Q. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural sealant glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
  2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- R. Design Modifications: Submit design modifications necessary to meet performance requirements and field coordination.
1. Variations in details or materials shall not adversely affect the appearance, durability, or strength of components, nor shall variations cause excessive stress, or deflections, to building structural frame.
  2. Maintain general design concept without altering size of members, profiles, and alignment.

#### 1.4 SUBMITTALS

- A. Combined Submittals: Combine submittals for exterior curtainwall and storefronts into a single submission. Submit combined shop drawing which has been reviewed, annotated, and coordinated by each of the principal exterior cladding subcontractors.
1. As an indication of review, and as a condition of acceptance by the Architect, provide combined submittal with a cover sheet clearly indicating the signatures of the Contractor and each exterior cladding subcontractor.
  2. Coordinate curtainwall, storefronts and entrances, windows, ACM, and window wall submittals.
- B. Product Data: Manufacturer technical data for each type of product, including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Submit plans, elevations, sections, full size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  2. Include full size isometric details of each vertical to horizontal intersection of glazed aluminum curtain walls, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
    - f. Thermal breaks.
    - g. Interface with building construction.
  3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
  4. Indicate glazing details, methods, locations of various types and thickness of glass, emergency breakout locations, and internal sealant requirements.

5. Indicate locations of exposed fasteners and joints for Architect's acceptance.
- D. Fabrication Sample (Mock Up Drawings): Submit drawings for field mockup of each vertical to horizontal intersection of assemblies, made from 12 inch (300 mm) lengths of full size components and showing details of the following:
  1. Joinery, including concealed welds.
  2. Anchorage.
  3. Expansion provisions.
  4. Glazing.
  5. Flashing and drainage.
- E. Delegated Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for the preparation.
- F. Structural Calculations: Submit sealed copies of structural calculations indicating complete compliance with the specified performance requirements. Submit calculations prepared, signed, and sealed by a Professional Engineer licensed in the State of Texas.
- G. Preconstruction Laboratory Mockup Testing Submittals: Submit the following:
  1. Testing Program: Developed specifically for Project.
  2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
  3. Record Drawings: Record drawings prepared from as built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.
- H. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
  1. Basis for Certification: NFRC certified energy performance values for each glazed aluminum curtain wall.
- I. Reports: Submit the following:
  1. Product Test Reports: Submit report for tests performed by a qualified testing agency.
  2. Quality Control Program: Program developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality control reports.
  3. Source quality control reports.
  4. Field quality control reports.
- J. Maintenance Data: Submit maintenance data to include in maintenance manuals.
- K. Maintenance Data for Structural Sealant: For structural sealant glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality control program.

## **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Building Code: Comply with applicable requirements of IBC with Austin amendments for building cladding.
  2. Energy Code: Comply with applicable provisions of the IECC.
  3. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame Spread Index: 25 or less.
    - b. Smoke Developed Index: 450 or less.

4. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
  5. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 *Structural Welding Code - Steel* and AWS D1.2 *Structural Welding Code - Aluminum*.
  6. Federal Standard 16 CFR 1201, Consumer Product Safety Commission (CPSC): *Safety Standard for Architectural Glazing Materials*, published in Code of Federal Regulations (CFR).
    - a. Comply with applicable requirements of authorities having jurisdiction, wherever requirements conflict the more stringent shall be required. Obtain approvals from authorities.
    - b. As a minimum provide safety glazing complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
  7. Structural Sealant Glazing: Comply with ASTM C 1401 for design and installation of structural sealant glazed curtain walls.
  8. Energy Performance Standards: NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- B. Manufacturer/Fabricator Qualifications: Fabricator specializing in the fabrication of aluminum framed window wall and window systems and components, having minimum 10 years documented experience, and with sufficient production capacity, organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and install the entrance assemblies required.
- C. Installer Qualifications: Firm that specializes in the erection of aluminum framed window wall, storefront, and window systems, having minimum 10 years documented experience, and approved or certified by manufacturer/fabricator.
1. Engineering Responsibility: Prepare data for curtainwall, storefront, and window systems, including Shop Drawings, based on testing and engineering analysis of manufactured units in systems similar to those indicated.
    - a. Professional Engineer Qualifications: A professional engineer who is legally licensed to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of heavy glass storefront and entrance system similar to those indicated in material, design, and extent.
- D. Laboratory Mockup Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- E. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- G. Structural Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.
- H. Source Limitations: Obtain components of curtain wall system, including framing entrances and accessories, from single manufacturer.
- I. Preinstallation Conference: Conduct conference at site.
- J. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  1. Build mockup of typical wall area as shown on Drawings.
  2. Perform testing on mockups according to specified requirements.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- K. Preconstruction Laboratory Mockups:
  1. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform testing on preconstruction laboratory mockups.
  2. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
    - a. Size and Configuration: As indicated on Drawings.
    - b. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.
  3. Preconstruction Laboratory Mockup Testing Program: Test preconstruction laboratory mockups according to requirements. Perform the following tests in the following order:
    - a. Structural: ASTM E 330 at 50 percent of positive test load.
    - b. Air Infiltration: ASTM E 283.
    - c. Water Penetration under Static Pressure: ASTM E 331.
    - d. Water Penetration under Dynamic Pressure: AAMA 501.1.
    - e. Structural: ASTM E 330 at 100 percent of positive and negative test loads. Repeat the following:
      - 1) Air Infiltration: ASTM E 283.
      - 2) Water Penetration under Static Pressure: ASTM E 331.
    - f. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
      - 1) Air Infiltration: ASTM E 283.
      - 2) Water Penetration under Static Pressure: ASTM E 331.
    - g. Vertical Interstory Movement: AAMA 501.7. Repeat the following:
      - 1) Air Infiltration: ASTM E 283.
      - 2) Water Penetration under Static Pressure: ASTM E 331.
    - h. Thermal Cycling: According to AAMA 501.5. Repeat the following:
      - 1) Air Infiltration: ASTM E 283.
      - 2) Water Penetration under Static Pressure: ASTM E 331.

- i. Structural: ASTM E 330 at 100 and 150 percent of positive and negative test loads. Repeat the following:
  - 1) Air Infiltration: ASTM E 283.
  - 2) Water Penetration under Static Pressure: ASTM E 331.
  
- L. Laboratory Mockup Testing: Curtain wall mock up testing shall include components of fixed window units, glazed framing including captured mullions and SSG mullions, and storefront units in mock up.
  1. Laboratory Mockup Testing: Provide mockups as specified for testing. Verify required mockup submittals are reviewed and have received final approval from the Architect prior to construction of the mockups.
    - a. Laboratory testing mockups are used as a standard for judging visual and performance acceptability of the Work for the project. Replace unsatisfactory work as directed. Provide personnel to construct exterior wall mockups who will be the same personnel who will be performing and supervising the actual Work. Simulate actual construction conditions as accurately as possible in every way. Provide extra materials necessary to replace any which fail during tests. Cut glass used in mockups to the minimum tolerances expected in the final exterior wall installation.
    - b. Size: As shown but not less than the requirements of AAMA Standard 501 and ASTM E 331 Section 9. Provide larger mockup(s) if the proposed exterior wall details create a condition requiring a larger mockup(s) for proper evaluation and testing. Provide mockups at wall testing facility complete with glass, aluminum framing, metal panels, anchors, connections, flashings, sealants, and joint fillers as accepted on the mockup shop drawings. Do not take special precautions or use techniques that do not represent those to be used on the work.
    - c. Laboratory Testing: Notify the Architect of the readiness of the mockups for preliminary and final testing. Do not begin the testing program without the presence of the Owner's representative and the Architect.
      - 1) Preliminary Test: Conduct single static pressure test at 50 percent of the maximum Wind Pressure followed by a single test for water penetration at 50 percent of the pressure specified.
        - a) The preliminary test is purposely limited to a single event. No interim or repeat preliminary testing for Contractor benefit or correction of systems shall be permitted.
      - 2) Perform tests of the mockup(s) in accordance with the standards except as modified, in the order listed, and in accordance with the specified performance criteria. Tests 1 and 5 shall be conducted at 1.57 lbf/sq. ft. (75 Pa) and 6.24 lbf/sq. ft. (300 Pa), respectively. Tests 2, 3, and 6 shall be conducted at 12 lbf/sq. ft. (600 Pa) for 1 cycle, maintaining the test pressure for 15 minutes.
        - a) Test 1 (For Air Infiltration): ASTM E 283. Extraneous air leakage (tare) shall be limited to 10 percent or less of the net air leakage through the exterior wall assembly as provided under ASTM E 283. Provide pressure taps as required within the test chamber to ensure uniform stratification of design test pressure across the exterior wall assembly.
        - b) Test 2 (For Water Penetration - Uniform Static Pressure): ASTM E 331.
        - c) Test 3 (For Water Penetration - Dynamic Pressure): AAMA 501.1.
        - d) Test 4 (For Structural Performance): ASTM E 330, Method B, test to .5, and 1.0 times the wind pressure, during test. Deflection readings shall be taken at end connections and midspans of main framing members, at intersections of framing members and at midspans of glass holding members, glass, and panels. Take readings for both positive and negative loading. If failure occurs through glass breakage prior to achieving 1.5 times the maximum wind pressure, replace glass and repeat test. Two successive failures of the same light or panel not

otherwise attributable to inherent glass defects will be considered unacceptable. Further tests shall be suspended until deficiencies are corrected, which may include increasing the stiffness of glass holding members and/or adjustment of the glazing details.

- e) Test 5 (Retest for Air Infiltration): ASTM E 283. Extraneous air leakage (tare) shall be limited to 10 percent or less of the net air leakage through the exterior wall assembly as provided under ASTM E 283. Provide pressure taps as required within the test chamber to ensure uniform stratification of design test pressure across the exterior wall assembly.
  - f) Test 6 (Retest for Water Penetration, Uniform Static Pressure): ASTM E331.
  - g) Test 7 (For Structural Performance): ASTM E 330, Method B, except conduct test to 1.5 times the maximum wind pressure. Record pressures and deflections at 1.5 times the wind pressure, during test.
  - h) Test 8 (For Live Load Deflection Performance): AAMA 501.4 Modified. Test for live load deflection by applying vertical load to the frame supporting the mockup specimen, so as to induce a deflection in the mockup equivalent to the live load deflection identified on the drawings at the location the mockup is simulating. The load shall be applied and released through ten (10) cycles. Visually inspect mockup specimen after each displacement.
  - i) Test 9 (Exterior Window Maintenance Equipment Test): Perform concentrated load testing on the exterior wall maintenance tie back equipment attached to the exterior wall framing. Apply outward, inward, and side-loading of a magnitude and for a duration as required to comply with the authorities having jurisdiction for window washing equipment. There shall be no failure or gross permanent distortion of the tie back equipment or any part of the exterior wall framing.
  - j) Test 10 (For Thermal Transmittance and Condensation Resistance): At the completion of Test 9, carefully disassemble the glass, glazing, and metal framing components and reassemble them as a mockup, and test the mockup, in accordance with AAMA 1503.1.
- d. Corrective Measures: Correct deficiencies in mockups observed during testing and repeat tests as required to show compliance with performance standards. Deficiencies requiring repair or modification to mockup(s) require complete retesting of mockup(s) beginning with the specified Preliminary Test unless otherwise directed by the Architect.
- 1) The Owner will pay the cost of the first mock up test. The cost of subsequent tests and retesting is the responsibility of the contractor. The Contractor shall bear costs for additional retesting until compliance with performance standards is accomplished.
  - 2) Incorporate corrective measures indicated by the test report into the final exterior wall assemblies after review by the Architect.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Identify components of curtainwall work after fabrication by marks clearly indicating location in the building. Package components to protect components from damage during shipping and handling.
- B. Storage on Site: Store units, components, and materials in clean, dry location, away from uncured concrete, masonry work, sprayed on fireproofing work, and construction activities. Cover with nonstaining waterproof paper, tarpaulin, or polyethylene sheeting to permit circulation of air inside the covering.

- C. Keep handling on site to a minimum. Exercise care to avoid damage to finishes of metals or breakage of glass.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so curtainwall work is accurately designed, fabricated, and fitted to the structure. Indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating curtainwalls without field measurements. Coordinate supporting structure construction to ensure actual dimensions correspond to established dimensions.

## 1.8 WARRANTY

- A. Assembly Warranty: Written warranty signed by manufacturer, Contractor, and Installer in which the manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including, but not limited to, excessive deflection.
    - c. Glass breakage due to defective design.
    - d. Noise or vibration created by wind and thermal and structural movements.
    - e. Deterioration of metals metal finishes and materials beyond normal weathering.
    - f. Water penetration through fixed glazing and framing areas.
    - g. Deterioration of materials and finishes beyond normal weathering.
    - h. Failure of insulating glass.
    - i. Noise or vibration created by wind and thermal and structural movements.
    - j. Failure of operating components.
  - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory applied finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 FRAMING

- A. Basis of Design Manufacturer/Product: Kawneer North America, 1600 Series or equivalent product from list of approved manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Arcadia, Inc.
  - 2. Bruce Wall Systems Corporation.
  - 3. CMI Architectural.

4. EFCO Corporation.
  5. EXTECH/Exterior Technologies, Inc.
  6. Oldcastle Building Enclosure.
  7. Pittco Architectural Metals, Inc.
  8. SAFTI FIRST Fire Rated Glazing Solutions.
  9. Trulite Glass & Aluminum Solutions, LLC.
  10. Tubelite Inc.
  11. U.S. Aluminum; a brand of C.R. Laurence.
  12. Unitized Systems LLC.
  13. Vistawall International.
  14. Vitro America.
  15. Waltek & Company Limited.
  16. Wausau Window and Wall Systems; Apogee Wausau Group.
  17. YKK AP America, Inc.
- B. Framing Members: Extruded or formed aluminum framing members of thickness required and reinforced necessary to support imposed loads.
1. Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Front.
  4. Finish: Powder coated.
  5. Color: Bronze.
  6. Fabrication Method: Factory fabricated unitized system.
- C. Aluminum Curtain Wall System: Kawneer Co., Inc., 1600 Series or equivalent product from list of approved manufacturers:
1. Structural Properties:
    - a. Limit the dead load deflection of horizontal members supporting glass to 1/175 of the clear span with a 1/8 inch maximum deflection.
    - b. Limit the deflection of any member in a direction parallel to the plane of the wall and of any corner mullion in both parallel and perpendicular directions to a maximum of 25 percent of the glass bite dimension and maintain a minimum of 1/8 inch clearance between the member and the edge of the glass, panel, or other component.
    - c. Limit the wind load deflection of any member to 1/240 plus 1/4 inch of the clear span, based on "pinned" ends.
    - d. Limit the wind load deflection of corner mullions to the span as specified above, with the specified pressure acting on one face of the building with no pressure acting on the adjacent face, or 1/2 the specified pressure acting on one face of the building with 1/2 the specified suction acting on the adjacent face, whichever is the greatest.
    - e. No wall element shall sustain permanent deflection of glass breakage under maximum design load.
    - f. The panels and their connections shall accommodate movements of the structure resulting from lateral forces. Provide connections with sufficient ductility to preclude brittle failure, at or near, welds.
- D. Framing Sizes: 2-1/2 inches x 6-3/4 inches where indicated on the drawings. Miter ends of horizontals to form segmented curve at commons
- E. Pressure Caps: Aluminum components that mechanically retain glazing with snap on aluminum trim that conceals fasteners.
- F. Brackets and Reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.



- G. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.
  2. Steel Reinforcement: Zinc rich, corrosion resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
    - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    - b. Cold Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    - c. Hot Rolled Sheet and Strip: ASTM A 1011/A 1011M.
  3. Carbon Steel: ASTM A36.

## 2.2 ENTRANCES

- A. Entrances: Comply with Section 08 41 00.

## 2.3 GLAZING

- A. Glazing: Comply with Section 08 80 00.
- B. Glazing Gaskets: Comply with Section 08 80 00.
- C. Glazing Sealants: Recommended by manufacturer.
- D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtainwall assembly indicated.
  1. Color: Architect to select from manufacturer's full range of colors.
- E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural sealant, weatherseal sealant, and structural sealant glazed curtainwall manufacturers for this use.
  1. Color: Match structural sealant.

## 2.4 ACCESSORIES

- A. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.
- B. Anchors: Three way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold applied asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

## 2.5 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from interior.
  6. Provisions for safety railings mounted on interior face of mullions.
  7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
  8. Components curved to indicated radii.
- D. Fabricate components to resist water penetration:
  1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
  2. Pressure equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtainwall Framing: Fabricate components for assembly using shear block system.
- F. Factory Assembled Frame Units:
  1. Rigidly secure nonmovement joints.
  2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
  3. Preparation includes, but is not limited to, cleaning and priming surfaces.
  4. Seal joints watertight unless otherwise indicated.
  5. Install glazing to comply with requirements in Section 08 80 00.
- G. After fabrication, clearly mark components to identify locations according to Shop Drawings.

## 2.6 ALUMINUM FINISHES

- A. Powder Coated: AAMA 2604 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  1. Color and Gloss: Bronze.

## **2.7 SOURCE QUALITY CONTROL**

- A. Structural Sealant: Perform quality control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine openings, substrates, adjoining construction, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work.
  - 1. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and built in components to ensure weathertight window wall installation.
  - 2. Notify Architect in writing, of dimensions, or conditions, found which prevent proper execution of the window wall work, including specified tolerances.
- B. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 PREPARATION**

- A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

### **3.3 INSTALLATION**

- A. Coordinate installation with building enclosure work.
- B. Comply with manufacturer's written instructions for installing curtain wall, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
  - 1. Do not install damaged components.
  - 2. Fit frame joints to produce hairline joints free of burrs and distortion.
  - 3. Rigidly secure nonmovement joints.
  - 4. Remove loose particles present or resulting from fabrication or field cutting and drilling by blowing out joints with oil free compressed air, or by vacuuming joints.
  - 5. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue.
  - 6. Do not allow solvent to air dry without wiping. Use lint free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) or xylene unless otherwise required by compatibility and adhesion testing results. Seal joints watertight. Clean excess joint sealants from finished surfaces.
  - 7. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 8. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
  - 9. Seal joints watertight unless otherwise indicated.
  - 10. Set components within erection tolerances with uniform joints. Place components on shims and fasten to supporting substrates using bolts and similar fasteners.
  - 11. Do not erect components that are warped, deformed, bowed, dented, defaced, or damaged and impair strength or appearance. Remove and replace members damaged in process of erection.

12. Coat concealed surfaces of dissimilar materials, and ferrous metal components, with heavy coating of bituminous paint, zinc rich primer or separation in accordance with manufacturer's recommendations. Where aluminum components will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
13. Do not burn, cut into or field drill holes or slots in building framing member without written acceptance of the structural engineer.

C. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Install components plumb and true in alignment with established lines and grades.

F. Permanently fasten to building structure with manufacturer recommended attachments and shims to permanently fasten system to building structure. Securely anchor components and units in place, allowing for required movement, including expansion and contraction. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weathertight construction.

G. Water Drainage: Compartmentalize each light of glass using joint plugs and silicone sealant to divert water to the horizontal weep locations. Locate weep holes in the horizontal pressure plates and covers to divert water to the exterior of the building.

H. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather stripping contact and hardware movement to produce proper operation.

I. Glazing: Install glazing gaskets and sealants in accordance with manufacturer's instructions without exception; including surface preparations. Refer to Section 088000.

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

J. Insulation and Fire Stopping: Refer to Section 07 21 00 and Section 07 84 00, respectively.

K. Weatherseal: Install weatherseal sealant according to Section 079200 and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

### 3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
  - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).

- c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.
5. Tolerances are not accumulative.

### 3.5 FIELD QUALITY CONTROL

- A. The Owner reserves the rights to engage an independent testing and inspection agency to verify the adequacy of the Contractor's quality control. Obtain inspections from representative of the Owner's independent testing and inspection agency. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.
- C. Field Quality Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
  1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
  2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
  3. Water Penetration: ASTM E 1105 at a minimum static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- D. Structural Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, *Hand Pull Tab (Destructive)*, Appendix X2.
  1. Repair installation areas damaged by testing.
- E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Remove and replace noncomplying windows and retest as specified.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.6 CLEANING

- A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.
- B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.
- C. Immediately remove deleterious material from surfaces of aluminum.

**3.7 PROTECTION**

- A. Institute protective measures required throughout the remainder of the construction period to ensure that window wall Work will be without damage or deterioration, other than normal weathering, at time of acceptance.

**END OF SECTION 08 44 13**

## **SECTION 08 51 00 - ALUMINUM WINDOWS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Aluminum windows for exterior locations.
  - 2. Accessories necessary for a complete installation.

#### **1.3 WINDOW PERFORMANCE REQUIREMENTS**

- A. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440:
- B. Solar Heat Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30
- C. Windborne Debris Impact Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product, including construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Submit plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.
- D. Samples: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
  - 1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
- E. Product Schedule: Use same designations indicated on Drawings.
- F. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- G. Field quality control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Energy Code: Provide window units compliant with the IECC with Texas amendments,

2. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - a. Window Certification: AAMA certified with label attached to each window.
3. Texas Department of Insurance, Windstorm Regulations; provide products listed in the Product Evaluation Index and having a current report number.
4. Accessibility Requirements: Comply with applicable requirements.
  - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
  - c. Texas Accessibility Standards (TAS).
- B. Manufacturer Qualifications: Manufacturer having minimum 5 years documented experience who is capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting the performance by test reports and calculations.
- C. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- D. Source Limitations: Obtain aluminum windows from single source from single manufacturer.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Build mockup of typical wall area as shown on Drawings.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at site.
  1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
  3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
  4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.
- G. Preinstallation Conference: Conduct conference at site.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Written warranty signed by Manufacturer in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
    - c. Faulty operation of movable sash and hardware.



- d. Deterioration of materials and finishes beyond normal weathering.
  - e. Failure of insulating glass.
2. Warranty Period:
- a. Window: 10 years from date of Substantial Completion.
  - b. Glazing Units: 10 years from date of Substantial Completion.
  - c. Aluminum Finish: 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Manufacturers: Subject to compliance with requirements, provide impact resistant window products by one of the following:
- 1. Arcadia, Inc.
  - 2. EFCO Corporation.
  - 3. Kawneer North America; an Alcoa company.
  - 4. Peerless Products, Inc.
  - 5. Wausau Window and Wall Systems; Apogee Wausau Group.
  - 6. Winco Manufacturing Co.
- B. Operating Types: Provide the following operating types in locations indicated on Drawings:
- 1. Casement: Project out.
  - 2. Awning: Project out.
  - 3. Hopper: Project in.
  - 4. Single hung.
  - 5. Double hung.
  - 6. Horizontal sliding.
  - 7. Fixed window.
- C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
- 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal to metal contact.
- D. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
- 1. Kind: Fully tempered.
- E. Windborne Debris Impact Resistant Insulating Glass: ASTM E 2190, factory assembled sealed glass unit units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
- 1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
  - 2. Spacer: Aluminum with black, color anodic finish.
  - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.
  - 4. Overall Unit Thickness: 1 inch (25 mm).
  - 5. Minimum Thickness of Each Glass Lite: 6 mm.
  - 6. Outdoor Lite: Low E tinted float glass, impact resistant laminated glass.
  - 7. Interspace Content: Air.
  - 8. Indoor Lite: Fully tempered float glass.
- F. Hardware: Provide hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- G. Projected Window Hardware:
  1. Gear Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
    - a. Type and Style: Selected by Architect.
  2. Hinges: Nonfriction type, not less than two per sash.
  3. Lock: Lift type throw, cam action lock with keeper.
  4. Pole Operators: Tubular shaped anodized aluminum; with rubber capped lower end and standard push pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches (1500 mm) above floor; one pole operator and pole hanger per room that has operable windows more than 72 inches (1800 mm) above floor.
- H. Hung Window Hardware:
  1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
  2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
  3. Tilt Latch: Releasing latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.
- I. Horizontal Sliding Window Hardware:
  1. Sill Cap/Track: Extruded aluminum track with natural anodized finish of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
  2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
  3. Roller Assemblies: Low friction design.
- J. Weather Stripping: Provide full perimeter weather stripping for each operable sash unless otherwise indicated.
- K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
  1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

## 2.2 ACCESSORIES

- A. Integral Ventilating System/Device: Where indicated, provide weather-stripped, adjustable, horizontal fresh air vent, with a free airflow slot, full width of window sash by approximately 1 inch (25 mm) when open, complying with AAMA/WDMA/CSA 101/I.S.2/A440. Equip vent bar with an integral insect screen, removable for cleaning.
- B. Dividers (False Muntins): Provide extruded aluminum divider grilles in designs indicated for each sash lite.
  1. Type: Permanently located between insulating glass lites.
  2. Pattern: Indicated on Drawings.
  3. Profile: Selected by Architect.

- C. Subsills: Thermally broken, extruded aluminum subsills in configurations indicated on Drawings.
- D. Column Covers: Extruded aluminum profiles in sizes and configurations indicated on Drawings.
- E. Interior Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.
- F. Panning Trim: Extruded aluminum profiles in sizes and configurations indicated on Drawings.
- G. Receptor System: Two piece, snap together, thermally broken, extruded aluminum receptor system that anchors windows in place.

### **2.3 FABRICATION**

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
  - 1. Angled mullion posts with interior and exterior trim.
  - 2. Angled interior and exterior extension and trim.
  - 3. Exterior head and sill casings and trim.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

### **2.4 FINISH REQUIREMENTS**

- A. Comply with NAAMM *Metal Finishes Manual* for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.5 ALUMINUM FINISHES**

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
  - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
  - 2. Air Infiltration Testing:
    - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.
  4. Testing Extent: Three mockup windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
  5. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.4 ADJUSTING, CLEANING, AND PROTECTION**

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
  1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

**END OF SECTION 08 51 00**

## **SECTION 08 56 59 – SERVICE AND TELLER WINDOWS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Horizontal lift transaction windows.

#### **1.3 COORDINATION**

- A. Coordinate installation of anchorages for transaction windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.5 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.
- B. Shop Drawings: For transaction windows.
  - 1. Include plans, elevations, sections, and attachments to other work.
  - 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
  - 3. Location of weep holes.
  - 4. Hardware for sliding window units.
  - 5. Glazing details.
  - 6. Details of deal tray, transaction drawer, transaction counter and speaking aperture.
- C. Samples for Initial Selection: For frame members with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Framing: 12-inch- (305-mm-) long sections of frame members.
- E. Cutaway Sample: Corner of transaction window, made from 12-inch (305-mm) lengths of full-size components, and showing details of the following:
  - 1. Joinery.
  - 2. Anchorage.
  - 3. Glazing.
  - 4. Flashing and drainage.

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
  - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Pack windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label transaction window packaging with drawing designation.
- C. Store crated transaction windows on raised blocks to prevent moisture damage.

## **1.8 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## **1.9 SEQUENCING**

- A. Field Painting: Except where transaction windows have been preglazed before installation, complete field painting of transaction windows before glazing installation.

## **1.10 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace transaction windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including deflections exceeding 1/4 inch (6 mm).
    - b. Failure of welds.
    - c. Excessive air leakage.
    - d. Faulty operation of sliding window hardware.
    - e. Faulty operation of transaction drawers.
    - f. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PASS THRU SPEAKER**

- A. Basis of Design: Model: SP-CS-NV-06 as manufactured by Armortex.
  - 1. Material: Cast Stainless Steel.
  - 2. Features:
    - a. Bullet Resistant Glazing.
    - b. Natural Voice Spacers.
    - c. Ballistic Steel.
  - 3. Tolerances:

- a. Fractionals (-/+) 1/16 inch.
- b. Angular: (-/+) 1 degree.
- c. Two Place Decimal: (-/+) .01.
- d. Three Place Decimal: (-/+) .005.

## 2.2 FABRICATION

- A. General: Fabricate transaction windows to provide a complete system for assembly of components and anchorage of window units.
  1. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.
  2. Prepare transaction windows for glazing unless preglazing at the factory is indicated.
- B. Provide weep holes and internal water passages for exterior transaction windows to conduct infiltrating water to the exterior.
- C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
  1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for transaction windows to comply with ballistics-resistance performance indicated.
- D. Glazing Stops: Finish glazing stops to match transaction window framing.
  1. Secure-Side (Exterior) Glazing Stops: Welded or integral to framing.
  2. Nonsecure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
- E. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- G. Factory-cut openings in glazing for speaking apertures.
- H. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated.
- I. Weather Stripping: Factory applied.

## 2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.



## **2.4 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## **2.5 ACCESSORIES**

- A. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Sealants: For sealants required within fabricated transaction windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of transaction windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of transaction window connections before transaction window installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of transaction windows.
- D. Inspect built-in and cast-in anchor installations, before installing transaction windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
  - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
  - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For glazing materials whose orientation is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other transaction window anchors whose installation is specified in other Sections.
  - 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

### **3.3 INSTALLATION**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing transaction windows to in-place construction. Include threaded fasteners for inserts, transaction fasteners, and other connectors.

1. Install an attached or integral flange to secure side of transaction windows extending over rough-in opening gap so that gap has same forced-entry-resistance and ballistics-resistance performance as transaction window.
- B. Glazed Framing: Provide sealant and gasket-glazed framing.
- C. Removable Glazing Stops and Trim: Fasten components with transaction fasteners.
- D. Fasteners: Install transaction windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.
- E. Sealants: Comply with requirements in Section 07 92 00 "Joint Sealants" for installing sealants, fillers, and gaskets.
  1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
  2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
- F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional Work. Prepare inspection reports.
- C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

### **3.5 ADJUSTING**

- A. Adjust horizontal-sliding, transaction windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
- B. Remove and replace defective Work, including transaction windows that are warped, bowed, or otherwise unacceptable.

### **3.6 CLEANING AND PROTECTION**

- A. Clean surfaces promptly after installation of transaction windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
  1. Lubricate sliding transaction window hardware.
  2. Lubricate transaction drawer hardware.
- B. Clean glass of preglazed transaction windows promptly after installation.
- C. Provide temporary protection to ensure that transaction windows are without damage at time of Substantial Completion.

**3.7 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain operable transaction windows.

**END OF SECTION 08 56 59**

## SECTION 08 71 00 – DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical door hardware.
  - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
  - 1. Division 08 Section "Door Hardware Schedule".
  - 2. Division 08 Section "Hollow Metal Doors and Frames".
  - 3. Division 08 Section "Interior Aluminum Doors and Frames".
  - 4. Division 08 Section "Plastic Laminate Faced Wood Doors".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series
  - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material

descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

- D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.
- E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- F. Informational Submittals:
  - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Integrated Wiegand, Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical

door hardware, unless otherwise indicated

- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  - 3. Review sequence of operation narratives for each unique access controlled opening.
  - 4. Review and finalize construction schedule and verify availability of materials.
  - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing hardware. Check Shop Drawings of other

work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### 1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Lifetime for mortise locks and latches.
  - 2. Five years for exit hardware.
  - 3. Ten years for electric latch retraction exit motors
  - 4. Twenty-five years for manual surface door closer bodies.
  - 5. Two years for electromechanical door hardware.
  - 6. Lifetime for SN200 readers.

#### 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

#### 1.9 OWNER STOCK – See Attic Stock at the end of Hardware Schedule.



## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

### 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  - 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on

Drawings:

- a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Acceptable Manufacturers:

- a. Hager Companies (HA).
- b. McKinney Products (MK).
- c. Stanley Hardware (ST).

- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Acceptable Manufacturers:

- a. McKinney Products (MK).
- b. Pemko Manufacturing (PE).
- c. Stanley Hardware (ST).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

- a. Pemko Manufacturing (PE) – EL-CEPT Series.
- b. Securitron (SU) - EL-CEPT Series.
- c. Stanley Hardware (ST) EPT-12C Series.

- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

- a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
- b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

## 2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
1. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Acceptable Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
  2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
  3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
  4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
  5. Acceptable Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).

## 2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
1. Acceptable Manufacturers:
    - a. Stanley Best (BE).

- b. Sargent Cylinder Housings
  - c. No Substitution.
- C. Cylinders: Original manufacturer cylinders complying with the following:
  - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
  - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  - 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  - 5. Keyway: Match Facility Standard.
- D. Keying System: Each type of lock and cylinders to be factory keyed.
  - 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
  - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  - 3. Existing System: Key locks to Owner's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
  - 1. Change Keys per Cylinder: Two (2)
  - 2. Twenty construction cores
  - 3. 50 Key Blanks – Best "A" Keyway
- F. Construction Keying: Provide temporary keyed construction cores. Green Best Cores No Substitution . All Best temporary cores to be returned to the district at the end of the project.
- G. Key Registration List (Bitting List):
  - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  - 2. Provide transcript list in writing or electronic file as directed by the Owner.
- H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project. Provide a new cabinet to all new construction projects. Use Lund 1205-B as a basis of design.
  - 1. Acceptable Manufacturers:
    - a. Lund Equipment (LU).
    - b. MMF Industries (MM).
    - c. Telkee (TK).

## 2.6 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13. Locksets are to be

manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Acceptable Manufacturers

- a. Sargent Manufacturing (SA) 8200 Series – No substitutions
- b. Sargent Manufacturing (SA) 10X Series - No substitutions
  - 1) Use at student restrooms or as directed by Cy Fair ISD

2.7 AUXILIARY LOCKS

A. Tubular Deadlocks: Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Acceptable Manufacturers:

- a. Marks (MX) - 130 Series.
- b. Sargent Manufacturing (SA) – 480 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

- 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- 2. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

- 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
- 2. Strikes for Auxiliary Deadlocks: BHMA A156.5.
- 3. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

- 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
- 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's

catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  6. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  7. Through Bolt Installation: For exit devices and trim as indicated (TB) in Door Hardware Sets.
  8. Provide Less Dogging (LD) at all exit devices.
  9. Add 31- Prefix to all exit devices being provided at two inch aluminum doors.
  10. No self-tapping screws allowed.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Acceptable Manufacturers:
    - a. Sargent Manufacturing (SA) - 80 Series.
    - b. No Substitution.
- C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.
1. Provide keyed removable feature where specified in the Hardware Sets.
  2. Provide stabilizers and mounting brackets as required.
  3. Provide electrical quick connection wiring options as specified in the hardware sets.
  4. Acceptable Manufacturers:
    - a. Stanley Precision (PR) - 822 Series.
    - b. No Substitution.

## 2.10 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL EXIT DEVICES

- A. Wiegand Output Integrated Card Reader Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated proximity card reader, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
  2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
  3. 12VDC external power supply required for reader, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). 24VDC required for solenoid operated exit trim (12VDC if applicable). Fail safe or fail secure options.
  4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
  5. Acceptable Manufacturers:
    - a. Sargent Manufacturing (SA) - SN – 56-SN20080 Series Exits. x SPAR04867
    - b. Sargent Manufacturing (SA) - SN – SN2008200 Series Locks.
    - c. No Substitution.

## 2.11 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
  2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
  4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
  5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.
  8. Through Bolt Installation: All door closers are to be installed with (TB) through bolting as indicated in Door Hardware Sets.
  9. No self-tapping screws allowed.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Acceptable Manufacturers:
    - a. Sargent Manufacturing (SA) – TB 351 Series.

## 2.12 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.
1. Acceptable Manufacturers:
    - a. LCN Door Closers (LC) - SEM7800 Series.
    - b. Rixson (RF) - 980/990 Series.
    - c. Sargent Manufacturing (SA) - 1560 Series.

## 2.13 ARCHITECTURAL TRIM

- A. Door Protective Trim
1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
  2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
  3. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop),



fabricated from the following:

- a. Stainless Steel: 300 grade, 050-inch thick.
4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
5. Acceptable Manufacturers:
  - a. Ives (IV).
  - b. Rockwood Manufacturing (RO).
  - c. Trimco (TC).

#### 2.14 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  1. Acceptable Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
  1. Acceptable Manufacturers:
    - a. Do not use overhead stops/holders

#### 2.15 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. No Replaceable Seal Strips allowed: Provide only those units where they can be screw applied..
- E. Acceptable Manufacturers:
  1. National Guard Products (NG).
  2. Pemko Manufacturing (PE).
  3. Reese Enterprises, Inc. (RE).

## 2.16 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
  1. Acceptable Manufacturers:
    - a. Provided by Security
- B. Switching Power Supplies: Provide UL listed or recognized filtered and regulated power supplies. Provide single, dual, or multi-voltage units as shown in the hardware sets. Units must be expandable up to eight Class 2 power limited outputs. Units must include the capability to incorporate a battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
  1. Acceptable Manufacturers:
    - a. Provided by Security

## 2.17 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.18 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

#### **3.2 PREPARATION**

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

#### **3.3 INSTALLATION**

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is

located.

- C. Integrated Wiegand access control products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.
- D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.
- G. No self-tapping screws allowed.

#### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

#### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- B. Final Adjustment: Installer shall return and make final adjustment of all hardware once all air conditioning test and balance is complete. Final adjustment shall be made while air conditioner system is operating. Coordinate with General Contractor and Owner.

#### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

- A. Manufacturer's Abbreviations:

- 1. MK - McKinney
- 2. OT - OTHER
- 3. PE - Pemko
- 4. RO - Rockwood
- 5. PR - Precision
- 6. MX - Marks
- 7. SA - Sargent
- 8. AD - Adams Rite
- 9. BE - Best Access Systems
- 10. HS - HES
- 11. SU - Securitron
- 12. KD - Keedex
- 13. LO - Locinox

**\*\*At existing doors / frames, all conditions must be field verified prior to order.  
At aluminum frames, gasket is by frame manufacturer.**

**Hardware sets based on plans dated 10/03/2024 - 50% CD  
12/4/2024 - revised per 75% hardware review  
1.2.2025 - additional 75% revisions**

**Set: 1.0**

Doors: J318

Description: 2N Station - Peep

1	Balance of hardware	Existing to remain		OT
2	Viewer	622 x door thickness	DCRM	RO

DOOR HARDWARE  
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1 2N Station 2N OT

**Set: 2.0**

Doors: E422, F100, G122, G201.1, G201.2

Description: Add Reader

1	SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1	Balance of hardware	Existing to remain		OT

Notes: Replace H1 Reader with SN200.

**Set: 2.1**

Doors: B811

Description: Add Reader x 8510 LD

	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 EO	US32D	SA
1	SN200 Reader	52 6027 (Exit / Lock)	26D	SA
1	Balance of hardware	Existing to remain		OT

Notes: Replace H1 Reader with SN200.

**Set: 3.0**

Doors: A901, B809, B810, B812, B814, B816, B818, D501, D502.1, D504.1, D505, D507, D509, D511, D512, D513, E402, E406, E407, E408, E409, E410, E411, E412.1, E413, F711

Description: Add Exit Device-8816- HO Closers

1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
1	Retrofit Kit	688 Kit for 8800 Series Trim	US26D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PSH	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

**Set: 4.0**

Doors: A913, D510, H304, H305.1

Description: Add Exit Device-8816- Sound

1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
1	Retrofit Kit	688 Kit for 8800 Series Trim	US26D	SA
2	Interchangeable Core	I/CK-7	626	BE

2	Const. Core	7190224	Green	BE
1	Door Closer	TB 351 O/P9 (type as required)	EN	SA
1	Balance of hardware	Existing to remain		OT

Notes: Add 31- to locks if doors are over 1 3/4" thick. Provide hold open closers if cam lift hinges are not used.

**Set: 5.0**

Doors: A913.1, H304.1, H305

Description: Add Exit Device-8804- Sound

1	Rim Exit SPAR NC-E11	LD 19 TB 43 70 8804 ETL	US32D	SA
1	Retrofit Kit	688 Kit for 8800 Series Trim	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer	TB 351 O/P9 (type as required)	EN	SA
1	Balance of hardware	Existing to remain		OT

Notes: Add 31- to locks if doors are over 1 3/4" thick. Provide hold open closers if cam lift hinges are not used.

**Set: 6.0**

Doors: D600, D600.1

Description: Add Exit Device-8816/8804 - HO Closers

1	Rim Exit Sec CR x SPAR#NC-E11	LD 19 LD 43 49 70 8816 ETL	US32D	SA
1	Rim Exit NL SPAR#NC-E11	LD 19 43 70 8804 ETL	US32D	SA
2	Retrofit Kit	688 Kit for 8800 Series Trim	US26D	SA
3	Interchangeable Core	I/CK-7	626	BE
3	Const. Core	7190224	Green	BE
2	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
2	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

**Set: 7.0**

Doors: D501.1, D502, D504, D505.1, D507.1, D508, D509.1, D510.1, D511.1, D512.1, D513.1, E412

Description: Add Exit Device-8804- HO Closers

1	Rim Exit NL SPAR#NC-E11	LD 19 43 70 8804 ETL	US32D	SA
1	Retrofit Kit	688 Kit for 8800 Series Trim	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PSH	EN	SA

1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

**Set: 8.0**

Doors: F100A

Description: Add 2N Narrow Exit 8504 x 8510, Loop Less Trim

1	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 EO	US32D	SA
1	Rim Exit xSPAR04867/NC-E11/NC-E35	LD 19 TB 43 56 70 8504 Less Trim	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
2	Door Stop	462	US2C	RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT
1	2N Station	2N		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. 8510 @ RHR.

**Set: 9.0**

Doors: F122, F124, J301, J301.1

Description: Add SN200 Narrow Exit 8504 x 8510, Less Trim - Loop

1	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 EO	US32D	SA
1	Rim Exit xSPAR04867/NC-E11/NC-E35	19 LD TB 43 70 56-SN200-8504 Less Trim	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
2	Door Stop	462	US2C	RO
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim. Add 12-



to rated openings.

**Set: 10.0**

Doors: H300, H301

Description: Add SN200 Narrow Exit - Ex Trim, Loop x 8510

1	Rim Exit SPAR NC-E11	LD 19 TB 43 8510 EO	US32D	SA
1	Rim Exit xSPAR04867/NC-E11/NC-E35	19 LD TB 43 70 56-SN200-8504 Less Trim	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim. Install SN200 at LHR

**Set: 11.0**

Doors: A624.1

Description: Add Pr - SN200 Exit Less Trim, Loop RHR

1	Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim. Install panic at RHR.

**Set: 12.0**

Doors: B813

Description: Add Pr SN200 Exit x 8810, Less Trim Loop

1	Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1	Rim Exit EO x SPAR#NC-E11	19 LD TB 43 8810	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
2	Door Stop	462	US2C	RO
1	Gasketing	2891APK (head & jambs)		PE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim. Install SN200 at RHR

**Set: 12.1**

Doors: B900

Description: Add Pr 8810 only, Less Trim

2	Rim Exit EO x SPAR#NC-E11	19 LD TB 43 8810	US32D	SA
2	Door Stop	462	US2C	RO
1	Gasketing	2891APK (head & jambs)		PE
1	Balance of hardware	Existing to remain		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim. Install SN200 at RHR

**Set: 13.0**

Doors: C608, C704.2

Description: \*\*Sgl - ExT -HM - Exit- SN200 - Closer /Stop- Access Control

1	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit x SPAR04867/NC-E11	19 LD TB 43 70 56-SN200-8804	US32D	SA
1	Vandal Resistant Trim	826	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer	TB 351 PS	EN	SA
1	Gasketing	2891APK (head & jambs)		PE
1	Rain Guard	346C x Frame Width		PE

DOOR HARDWARE  
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1	Sweep	345ANB x Dr. Width	PE
1	Threshold	2005AT MSES25SS X Opening Width	PE
1	ElectroLynx Harness	QC-C1500P	MK
2	ElectroLynx Harness	QC-C***P (length as req'd)	MK
1	Door Position Switch	By Security.	OT
1	Power Supply	Provided by security	SU

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

**Set: 14.0**

Doors: C702.2

Description: Add Sgl SN200 Exit PSB Loop

1	Rim Exit x SPAR04867/NC-E11	LD 19 TB 43 70 56-SN200-8804 PSB	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	462	US2C	RO
1	Gasketing	2891APK (head & jambs)		PE
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK
1	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU
1	Balance of hardware	Existing to remain		OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim. Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert

**Set: 15.0**

Doors: A901.1

Description: Add Sgl 2N Exit PSB Loop

1	Rim Exit 2N SPAR#04867/NC-E11	LD 19 TB 43 56 70 8804 PSB	US32D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	462	US2C	RO
1	Gasketing	2891APK (head & jambs)		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C***P (length as req'd)		MK
1	Door Loop	DL-2		AK

1 Door Position Switch	By Security.	OT
1 Power Supply	Provided by security	SU
1 Balance of hardware	Existing to remain	OT

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim. Remove cylinder dogging on exiting rail with 68-1375 mounting rail insert

**Set: 16.0**

Description: Not Used

1 Set	Not Used	OT
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**Set: 17.0**

Doors: D603, D608, G211, G227, H306

Description: Existing - Add 8204

1 Storeroom/Closet Lock	70 8204 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 18.0**

Doors: C604

Description: Existing - Add 8204 x 2

2 Storeroom/Closet Lock	70 8204 LL	US26D	SA
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE
2 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 19.0**

Doors: J302

Description: Existing - Add 8204 - Dummy Cyl

1 Storeroom/Closet Lock	70 8204 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Cylinder	Dummy Cylinder	US32D	SA
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 20.0**

Doors: A918.1

Description: Existing - Add 8204 - HO Closer - Classroom

1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

**Set: 21.0**

Doors: A909.1, A918, A925, A926, B919, B921, B922, B924, E401, E403, E405, F101, F102, F103, F104, F105, F106, F107, F108, F109, F110, F111, F112, F113, F114, F115, F116, F117, F118, F119, G225, G226, G236, G237, G238, H309

Description: Existing - Add 8238 - HO Closer

1	Classroom Security Intruder Lock	V01 EMB 70 8238 VN1L 90-3/8" Collar	US26D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

**Set: 22.0**

Doors: D619, G203, H308

Description: Existing - Add 8238

1	Classroom Security Intruder Lock	V01 EMB 70 8238 VN1L 90-3/8" Collar	US26D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Stop	481H	US26D	RO
1	Balance of hardware	Existing to remain		OT

**Set: 23.0**

Doors: E404

Description: Add Mullion

1	Mullion	KR822 (FLK as req)	600	PR
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2 Stabilizer	ST989	Dull Black	PR
1 Spacer	MCS822	689	PR
1 Interchangeable Core	I/CK-7	626	BE
1 Rim Cylinder	70 34 x 1KB-3	US32D	SA
1 Const. Core	7190224	Green	BE

**Set: 24.0**

Doors: B921.1, B922.1

Description: Existing - Add 8237 - dummy cylinder

1 Classroom Lock	70 8237 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Cylinder	Dummy Cylinder	US32D	SA
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 25.0**

Doors: A907, A911, A914, A915, A916, A917, A918E, B921A, B921B, B921C, B922A, B922B, B923, B923.1, B924A, B924B, C714, D508.1, D508.2, D508.3, D508.4, D508.5, D508.6, D508.7, D601, D601.1, D602, D602.1, D609, D609.1, D610, F705, F706, G228, H304C, H308.1, J303, J318.1

Description: No Work

1 All hardware	Existing to remain		OT
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**Set: 26.0**

Doors: F01B.1, F01G.1

Description: Existing - Add HO Closer

1 Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 27.0**

Doors: H304A, H304B, H304D, H304E, H304F, H305B

Description: No work

1 All hardware	Existing to remain		OT
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Notes:

**Set: 28.0**

Doors: H304G  
Description: No Work

All hardware	By the door manufacturer	OT
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Notes:

**Set: 29.0**

Doors: G119.1, G202, G207, G208, G209, G210, G212, G213, G214, G215, G216, G217, G218, G219, G219.1, G221, G222, G223, G230, G231, G232, G233, G234, G239, G240, J311

Description: Existing - Add 8205

1 Office/Entry Lock	70 8205 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 30.0**

Doors: A904, E01R

Description: Existing - Add 8250 - HO Closer

1 Hotel Guest Lock Lock	V20 LC 8250 VN1L	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Mortise Cylinder for Hotel Lock	1E-7G4 C208 RP3	626	BE
Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1 Door Stop	481H	US26D	RO
1 Balance of hardware	Existing to remain		OT

**Set: 31.0**

Doors: G226.1

Description: No Work

1 All hardware	Existing to remain	OT
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**Set: 32.0**

Doors: D611, D620, F706A, G204, H307A, J313

Description: No Work

1 All hardware	Existing to remain	OT
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**Set: 33.0**

Doors: A600

Description: \*\*Pr Ext - ASF - Exit Device- SN200/DT - KRMullion - Closer w/Stop Arm -Access Control

1	Continuous Hinge	CFM SLF-HD1 x Dr. Ht.		PE
1	Continuous Hinge	CFM SLF-HD1 PT x Dr. Ht.		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Mullion	KR822 (FLK as req)	600	PR
2	Stabilizer	ST989	Dull Black	PR
1	Spacer	MCS822	689	PR
1	Rim Exit xSPAR04867/NC-E11/NC-E35	19 LD TB 43 70 56-SN200-8504 862	US32D	SA
1	Rim Exit x SPAR#NC-E11	19 LD TB 43 8510 862	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
1	Rim Cylinder	70 34 X #90 - 1/2	US32D	SA
2	Const. Core	7190224	Green	BE
2	Kit	581-1/ 581-2 as required	EN	SA
2	Surface Closer	TB 351 P10	EN	SA
2	Door Stop	462	US2C	RO
2	Sweep IDF/MDF/Alum	18061CNB x Dr. Width		PE
1	Threshold	2005AT MSES25SS X Opening Width		PE
1	Perimeter Seal	By door mfr		OT
1	ElectroLynx Harness	QC-C1500P		MK
2	ElectroLynx Harness	QC-C***P (length as req'd)		MK
2	Door Position Switch	By Security.		OT
1	Power Supply	Provided by security		SU

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

**Set: 34.0**

Doors: H301.1, H320

Description: \*\*Sgl - Exit Device-Security CL - Closer - STC

3	Hinges	By the STC door manufacturer		OT
1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer	TB 351 O/P9 (type as required)	EN	SA
1	Door Stop	462	US2C	RO
1	Gasket, threshold, door bottom	By the STC door manufacturer		OT



Notes: Add 31- to locks if doors are over 1 3/4" thick  
 Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

**Set: 35.0**

Doors: H320.1

Description: \*\*Sgl - Exit Device-NL - Closer - STC - Classroom

3 Hinges	By the STC door manufacturer		OT
1 Rim Exit SPAR NC-E11	LD 19 TB 43 70 8804 ETL	US32D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer	TB 351 O/P9 (type as required)	EN	SA
1 Door Stop	462	US2C	RO
1 Gasket, threshold, door bottom	By the STC door manufacturer		OT

Notes: Add 31- to locks if doors are over 1 3/4" thick  
 Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

**Set: 35.1**

Doors: S100

Description: \*\*Sgl - Ext- Mech/Storage/Fire Riser - Closer w/Stop Arm

1 Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1 Storeroom/Closet Lock	70 8204 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer	TB 351 PS	EN	SA
1 Gasketing	2891APK (head & jambs)		PE
1 Rain Guard	346C x Frame Width		PE
1 Sweep	345ANB x Dr. Width		PE
1 Threshold	2005AT MSES25SS X Opening Width		PE
1 Door Position Switch	By Security.		OT

**Set: 36.0**

Doors: B801, B802, B803, B804, B805, B806, B807, B808, D604, D612

Description: Existing Frame CH- Sgl - Exit Device-Security CL - Closer/HO

1 Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1 Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2 Interchangeable Core	I/CK-7	626	BE
2 Const. Core	7190224	Green	BE

DOOR HARDWARE  
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1	Surface Closer	TB 351 PSH	EN	SA
1	Door Stop	481H	US26D	RO
3	Silencer	608		RO

Notes: At existing doors and frames, verify all existing conditions and modify hardware as required prior to purchase.

Contractor to fill, bondo and paint existing frame strikes where required.

**Set: 37.0**

Doors: D617

Description: Sgl - Exit Device-Security CL - Closer / HO

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PSH	EN	SA
1	Door Stop	481H	US26D	RO
1	Gasketing	2891APK (head & jambs)		PE

**Set: 38.0**

Doors: D617.1

Description: Sgl - Exit Device-NL - Closer / HO - Classroom

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Rim Exit NL SPAR#NC-E11	LD 19 43 70 8804 ETL	US32D	SA
4	Interchangeable Core	I/CK-7	626	BE
4	Const. Core	7190224	Green	BE
1	Surface Closer	TB 351 PSH	EN	SA
1	Door Stop	481H	US26D	RO
1	Gasketing	2891APK (head & jambs)		PE

**Set: 39.0**

Doors: H313, J304

Description: \*\*Pr - EX FR - Int Classroom CR x CR -Closer - EMHO /Floor - Armor

2	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Mullion	KR822 (FLK as req)	600	PR
2	Stabilizer	ST989	Dull Black	PR
1	Spacer	MCS822	689	PR
2	Rim Exit Classroom SPAR NC-E11	LD 19 TB 43 70 8813 ETL (12-)	US32D	SA
3	Interchangeable Core	I/CK-7	626	BE

1	Mullion Cylinder	70 34 x 1KB-3	US32D	SA
3	Const. Core	7190224	Green	BE
2	Door Closer	TB 351 O/P9 (type as required)	EN	SA
2	Armor Plate	K1050 36" CSK BEV	US32D	RO
2	Door Stop	481H	US26D	RO
2	Electromagnetic Holder - Floor MTD	980M	689	RF
1	Gasketing	2891APK (head & jambs)		PE
1	Mullion Gasketing	5110BL		PE

Notes: Provide silencer in lieu of gasketing at non-rated doors. Provide rated panics where required.

**Set: 40.0**

Doors: [A624.2](#)

Description: \*\*Pr - Int Classroom Sec CL x NL -Closer / HO

2	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Mullion	KR822 (FLK as req)	600	PR
2	Stabilizer	ST989	Dull Black	PR
1	Spacer	MCS822	689	PR
1	Rim Exit SPAR NC-E11	LD 19 TB 43 70 8804 ETL	US32D	SA
1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
4	Interchangeable Core	I/CK-7	626	BE
1	Mullion Cylinder	70 34 x 1KB-3	US32D	SA
4	Const. Core	7190224	Green	BE
2	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
2	Door Stop	481H	US26D	RO
1	Gasketing	2891APK (head & jambs)		PE
1	Mullion Gasketing	5110BL		PE

Notes:

**Set: 41.0**

Doors: [A624](#), C601.1, [C701](#), C701.1

Description: \*\*Pr - EX FR - CH - Int Classroom Sec CL x NL -Closer

2	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Mullion	KR822 (FLK as req)	600	PR
2	Stabilizer	ST989	Dull Black	PR
1	Spacer	MCS822	689	PR
1	Rim Exit SPAR NC-E11	LD 19 TB 43 70 8804 ETL	US32D	SA
1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA

4	Interchangeable Core	I/CK-7	626	BE
1	Mullion Cylinder	70 34 x 1KB-3	US32D	SA
4	Const. Core	7190224	Green	BE
2	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
2	Door Stop	481H	US26D	RO
1	Gasketing	2891APK (head & jambs)		PE
1	Mullion Gasketing	5110BL		PE

Notes:

**Set: 41.1**

Doors: C601

Description: \*\*Sgl - EX FR - CH - Int Classroom Sec CL -Closer

1	Continuous Hinge	CFM HD1 PT x Dr. Ht.		PE
1	Rim Exit Sec CR x SPAR#NC-E11	19 LD 43 49 70 8816 ETL	US32D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
1	Gasketing	2891APK (head & jambs)		PE

Notes:

**Set: 42.0**

Description: Not Used

1	Set	Not Used		OT
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**Set: 43.0**

Doors: H320C

Description: \*\*Sgl - Storeroom

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	481H	US26D	RO
3	Silencer	608		RO

**Set: 44.0**

Doors: [H321](#)

Description: \*\*Sgl - Storeroom - Closer - Gasket - Wide

3 Hinge (heavy weight)	<a href="#">T4A3786</a>	US26D	MK
1 Storeroom/Closet Lock	<a href="#">70 8204 LL</a>	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer	<a href="#">TB 351 O/P9 (type as required)</a>	EN	SA
1 Door Stop	<a href="#">481H</a>	US26D	RO
1 Gasketing	<a href="#">2891APK (head &amp; jambs)</a>		PE

**Set: 45.0**

Doors: [D615](#)

Description: \*\*Sgl - Storeroom - Closer - Armor

3 Hinge, Full Mortise	<a href="#">TA2714</a>	US26D	MK
1 Storeroom/Closet Lock	<a href="#">70 8204 LL</a>	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer	<a href="#">TB 351 O/P9 (type as required)</a>	EN	SA
1 Armor Plate	<a href="#">K1050 36" CSK BEV</a>	US32D	RO
1 Door Stop	<a href="#">481H</a>	US26D	RO
3 Silencer	<a href="#">608</a>		RO

**Set: 46.0**

Doors: [D618](#), [H305A](#)

Description: \*\*Sgl - Storeroom - Closer/HO - Gasket - Janitor

3 Hinge, Full Mortise	<a href="#">TA2714</a>	US26D	MK
1 Storeroom/Closet Lock	<a href="#">70 8204 LL</a>	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer w/ HO	<a href="#">TB 351 H (inswing)/ PSH (outswing) As Req</a>	EN	SA
1 Door Stop	<a href="#">481H</a>	US26D	RO
1 Gasketing	<a href="#">2891APK (head &amp; jambs)</a>		PE

**Set: 47.0**

Doors: [G224](#)

Description: \*\*Sgl - Office, Conf, Work, Sat Admin Offices, Lounge, Nurse - No Closer

3 Hinge, Full Mortise	<a href="#">TA2714</a>	US26D	MK
1 Office/Entry Lock	<a href="#">70 8205 LL</a>	US26D	SA

1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	481H	US26D	RO
1	Silencer	608		RO

**Set: 48.0**

Doors: G201A

Description: \*\*Sgl - Storeroom, Closer

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom/Closet Lock	70 8204 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer	TB 351 O/P9 (type as required)	EN	SA
1	Door Stop	481H	US26D	RO
1	Silencer	608		RO

**Set: 49.0**

Doors: C702.1, C702A, C704A, H307

Description: \*\*Sgl EX FR - CH Typ - Security Classroom - Closer - HO

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Classroom Security Intruder Lock	V01 EMB 70 8238 VN1L 90-3/8" Collar	US26D	SA
2	Interchangeable Core	I/CK-7	626	BE
2	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ CPSH (outswing) As Req	EN	SA
1	Kit	581-1/ 581-2 as required	EN	SA
1	Door Stop	481H	US26D	RO
3	Silencer	608		RO

Notes: Provide hold open closers at classrooms.

**Set: 50.0**

Doors: H320A, H320B, H320D

Description: \*\*Sgl - 8237 - Practice / Office STC

3	Hinges	By the STC door manufacturer		OT
1	Classroom Lock	70 8237 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Stop	481H	US26D	RO

1 Gasket, threshold, door bottom By the STC door manufacturer OT

Notes: Add 31- to locks if doors are over 1 3/4" thick  
Door hardware is specified for design intent. Confirm hardware compatibility and design meets the door manufacturer's approved assembly testing for the STC level indicated.

**Set: 51.0**

Doors: E04B, E04G, F01B, F01G, J03B, J03G, J317  
Description: \*\*Sgl Ex Frame - CH- Multi Occ RR - Classroom Cyl - Closer

1	Continuous Hinge	CFM HD1 x Dr. Ht.		PE
1	Classroom Lock	70 10XG37 LL	US26D	SA
1	Interchangeable Core	I/CK-7	626	BE
1	Const. Core	7190224	Green	BE
1	Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1	Door Stop	481H	US26D	RO
3	Silencer	608		RO

Notes: Contractor to bondo and paint frames.

**Set: 52.0**

Doors: S100A  
Description: \*\*OH Coiling Doors - Manual

1 All hardware By the door manufacturer OT

**Set: 53.0**

Doors: A901.2, D613.1  
Description: No Work

1 All hardware By the door manufacturer OT

Notes: Provide keyswitch on both sides of door.

**Set: 54.0**

Doors: A03E, A623, A907.1, A909, A910, A912, A918A, A918B, A918C, A918D, A927, B919A, B919B, B919C, B920, B920.1, C602, C603, C606, C609, C610, C701A, C701B, C701C, C701D, C702, C703, C703.1, C704, C704.1, D02E, D07M, D08M, D503, D506, D513A, D603.1, D604A, D605, D606, D612.1, D613, D614, D616, D621, D626, E05M, E05M.1, E08M, E421, E424, E426, E428, E449, E452, F01C, F01M, F711.1, G01M, G01W, G02M, G02S, G03M, G03S, G205, G206, G207B, G215.1, G227.1, G229, G237B, H01E, H03C, H305C, H306A, H307B, J04C, J04M, J312, J316  
Description: No Work

1 All hardware Existing to remain OT

**Set: 55.0**

Doors: E429, E430

Description: \*\*Sgl - Multi Occ RR - Classroom Cyl - Closer

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	70 10XG37 LL	US26D	SA
1 Interchangeable Core	I/CK-7	626	BE
1 Const. Core	7190224	Green	BE
1 Door Closer w/ HO	TB 351 H (inswing)/ PSH (outswing) As Req	EN	SA
1 Door Stop	481H	US26D	RO
1 Gasketing	2891APK (head & jambs)		PE

**Set: 56.0**

Description: Advise

1 Review Advise OT

**Set: 57.0**

Doors: Attic

Description: \*\*Attic Stock - EVERY CAMPUS

1 Hydraulic Gate Closer & Hinge	MAMMOTH-180-HD	9005	OT
5 Quick Fix Bolts	MAMMOTH-P00006000		OT
5 Mullion Lock	98-2520		SA
5 Mullion Lock	98-2518		SA
5 Classroom Security Intruder Lock	8238 Lock Body	US26D	SA
5 130KB	Thumbturn Kit	26D	SA
50 Key Blanks	Best "A" Keyway		BE
12 Regular Hold Open Arm	25-H	EN	SA
12 Parallel Hold Open Arm	25-PSH	EN	SA
4 Electromagnetic Holder	994M 24VAC	689	RF
5 994M Magnetic Parts	Door Armature 994510M	689	RF
5 994M Magnetic Parts	Screw & Backplate 998300	689	RF
5 994M Magnetic Parts	Swivel Armature 900-3	689	RF
5 994M Magnetic Parts	Magnet Assembly 998369-3V	689	RF
5 994M Magnetic Parts	Wall Cover 998315M	689	RF
4 SN200 Reader	52 6027 (Exit / Lock)	26D	SA

Notes: All attic stock ships direct to  
Director of Technical Services  
Cy Fair ISD Lockshop



PBK Architects  
Project No. 220023

2022 Arnold MS Renovation  
Cypress-Fairbanks Independent School District

11430 Perry Road  
Houston, Texas 77064  
Fair.

\*\*DO NOT ship to jobsite. Distributor to ship directly to Cy

**END OF SECTION 08 71 00**

DOOR HARDWARE  
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## **SECTION 08 80 00 - GLAZING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Float glass.
  2. Tempered glass.
  3. Laminated glass.
  4. Impacted resistant glass.
  5. Acoustical glass.
  6. Segmentation Impact Resistant (IR) glass.
  7. Glazing sealants.
  8. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.
- B. Interspace: Space between lites of an insulating glass unit.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
  1. Design Wind Pressures: Indicated on Drawings.
  2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on the Drawings.
    - b. Basic Wind Speed: As indicated on the Drawings.
    - c. Importance Factor: 1.0.
  3. Exposure Category: C.
  4. Design Snow Loads: Indicated on Drawings.
  5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.

7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.
- B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: Submit glass product certificates required by Code.
  1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
  1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
    - a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
  2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
  1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
  2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements of the IBC for glazing.
  2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
    - a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission *Safety Standard for Architectural Glazing Materials*, published in the Code of Federal Regulations) and ANSI Z97.1.
    - b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
  3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
  4. Glazing Publications: Comply with published recommendations of glass product organizations.
    - a. GANA: Glazing Manual.
    - b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
    - c. GANA: Laminated Glazing Reference Manual.
    - d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
    - e. AAMA: TIR A7 Sloped Glazing Guidelines.
    - f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
    - g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
  5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
  6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
    - a. Minimum Glass Thickness for Exterior Lites: 1/4 inch (6 mm).
    - b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
  7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
    - a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
    - b. Where fully tempered float glass is indicated, provide fully tempered float glass.
- B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.
- F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

- G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
- I. Install glazing in mockups specified in Section 08 41 13 to match glazing systems required for Project, including glazing methods.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- J. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- K. Preinstallation Conference: Conduct conference at site.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.
- E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### **1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

- C. Existing framing to be modified to accept new laminated / insulated laminated security glazing by Global Industries. All impact Glazing and framing systems to receive new sill flashing with welded end dams, water diverters, sealant at framing joints, and proper weeping. The glazier will be expected to warranty glass for five (5) years, including damage that may be done to glass from faulty installation of frames e.g. delamination of laminated security glass due to water intrusion. Security glass must be caulked with structural sealant to the frame using Dow Corning 995.

## 1.9 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

## 1.10 WARRANTY

- A. Written warranty, executed by glass manufacturer agreeing to repair or replace glass units that fail in materials and workmanship or deteriorate within warranty period. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to decorative glass manufacturer's published instructions.
  - 1. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- D. Coated Glass Products: Furnish 10 year written warranty from substantial completion date made out to Owner and signed by coated- glass manufacturer agreeing to furnish replacements for those coated-glass units that deteriorate within the specified warranty per

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Glass:
    - a. AFG Industries.
    - b. Ford Glass Industries
    - c. Guardian Industries Corp.; SunGuard.
    - d. LOF Glass, Inc.
    - e. PPG Industries.
    - f. Saint-Gobain/ Euroglass.
  - 2. Segmentation Impact Resistant (IR) Glass:
    - a. Global Industries.
    - b. Comparable product approved by Architect.

- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Safety Glass: Comply with ANSI Z97.1 and testing requirements of CPSC 16CFR Part 1201 for Category II materials.
- D. Adhered Backing: Adhered scrim backing to ceramic coated surface; provide backed units identical to materials which, while possibly developing cracks and fissures, show no shear nor develop any openings large enough for the unobstructed penetration of 3 inch diameter sphere when tested by approved independent testing laboratory:
  - 1. Mount test specimens consisting of 3 glass assemblies, 34" x 76" (plus zero or minus 3/16 inch), for testing as specified in ANSI Z-97.1.
  - 2. Expose specimens to 100 cycles of the following conditions:
    - a. 1 hour at 0 degrees F, ambient humidity.
    - b. 3 hours increase from 0 degrees F to 140 degrees F, 95 to 100 percent relative humidity.
    - c. 1 hour at 140 degrees F, 95 to 100 percent relative humidity.
    - d. 3 hours decrease from 140 degrees F to 0 degrees F, ambient humidity.
  - 3. Break glass by springloaded prick punch at midpoint of either vertical edge.
  - 4. After breaking glass, subject it to pressure of 4 lbf per sq. ft. for 5 minutes to simulate wind load.
  - 5. Inorganic Opacifier: Provide polyethylene opacifier where no insulation and other backing material is applied directly to spandrel glass. Use polyester where direct attachment does occur.
  - 6. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C 1048.

## 2.2 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne Debris Impact Resistant Laminated Glass: Comply with requirements for laminated glass except laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions:

## 2.3 INSULATING GLASS

- A. Insulating Glass Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
- B. Performance Properties:
  - 1. Basis of Design Product: SNX51/23 as manufactured by Guardian Sunguard.
  - 2. Outboard-Inboard Substrate: Clear-Clear.
  - 3. Overall Unit Thickness: 1 inch (25 mm).
  - 3. Minimum Thickness of Each Glass Lite: 1/4 inch (6 mm).

4. Outdoor Lite: Fully tempered float glass.
  5. Interspace Content: Air.
  6. Indoor Lite: Fully tempered float glass.
  7. Winter Nighttime U-Factor: 0.29 maximum.
  8. Solar Heat Gain Coefficient: 0.27 maximum.
  9. Light to Solar Gain (LSG): 2.31.
- C. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum.
  2. Manufacturers: Subject to compliance with requirements, provide products by Technoform Glass Insulation NA, Inc.
  3. Desiccant: Molecular sieve or silica gel, or a blend of both.
- D. Fire Protection Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on positive pressure testing according to NFPA 257 or UL 9, including the hose stream test, and complying with NFPA 80. For ratings 60 minutes or greater, glazing shall meet the test requirements of ASTM E119 or UL 263.
- E. Fire Protection Rated Glazing Labeling: Permanently mark fire protection rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction indicating manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 degrees F (250 degrees C) temperature rise limitation; and the fire resistance rating in minutes.

## 2.4 GLAZING ACCESSORIES

- A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- C. Colors of Exposed Glazing Sealants: Selected by Architect.
- D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - d. Pecora Corporation.
    - e. Sika Corporation.
- E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation; Construction Systems.
    - b. Dow Corning Corporation.
    - c. GE Construction Sealants; Momentive Performance Materials Inc.
    - d. May National Associates, Inc.; a subsidiary of Sika Corporation.



- e. Pecora Corporation.
  - f. Polymeric Systems, Inc.
  - g. Sika Corporation.
- F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bostik, Inc.
    - b. Dow Corning Corporation.
    - c. GE Construction Sealants; Momentive Performance Materials Inc.
    - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - e. Polymeric Systems, Inc.
    - f. Schnee-Morehead, Inc., an ITW company.
    - g. Sika Corporation.
- G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation; Construction Systems.
    - b. Bostik, Inc.
    - c. Dow Corning Corporation.
    - d. GE Construction Sealants; Momentive Performance Materials Inc.
    - e. May National Associates, Inc.; a subsidiary of Sika Corporation.
    - f. Pecora Corporation.
    - g. Polymeric Systems, Inc.
    - h. Schnee-Morehead, Inc., an ITW company.
    - i. Sika Corporation.
- H. Glazing Sealants for Fire rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Corning Corporation.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
  - 2. Colors of Exposed Glazing Sealants: Selected by Architect.
- I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
- 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
- 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials

for application indicated, and with proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
5. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
6. Perimeter Insulation for Fire Resistive Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

## 2.5 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
  2. Edge and Surface Conditions: Comply with the recommendations of AAMA *Structural Properties of Glass* for clean cut edges, except comply with manufacturer's recommendations.
  3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
  2. Presence and functioning of weep systems.
  3. Minimum required face and edge clearances.
  4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

### 3.2 PREPARATION

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
  2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.

### **3.3 GLAZING**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
  2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
  3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
  4. Do not remove release paper from tape until right before each glazing unit is installed.
  5. Apply heel bead of elastomeric sealant.
  6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
  7. Apply cap bead of elastomeric sealant over exposed edge of tape.
- L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
  2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
  3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
  4. Install gaskets to protrude past face of glazing stops.
- M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
  2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
  2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.
  3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.

4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.

O. Erection Tolerances:

1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
4. Maximum Joint Gap: 1/32 inch.

### 3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

## PART 4 – SCHEDULE

### 4.1 GLAZING SCHEDULE

- A. GL1 Thermally Insulated Glass: 1 inch sealed insulated unit consisting of an exterior lite of 1/4 inch low-e tinted tempered float glass, 1/2 inch gas filled air space, and 1/4 inch clear tempered float glass interior lite.
  1. Basis of Design: Thermal Gray as manufactured by Guardian.
- B. GT1: 1/4 inch Clear, Float Glass.
- C. SG1: Monolithic Security, Insulated Glazing: Childgard-2118 Security Glazing or comparable product approved by Architect. Refer to Section 08 88 53.
  1. Overall Unit Thickness: 3/8 inch.
  2. Interior Pane: Childgard-2118 Security Glazing by Global Security Glazing or other CGH Inc. Company
    - a. Forced Entry Resistance: ASTM F1233 Class 1.4
    - b. Forced Entry Resistance: 5-aa1 rated for a minimum of 16 minutes
    - c. Bullet Resistance: HP White-TP-0500.03 Level A
      1. .38 special handgun, 3 shots in an 8" circle, 158 grain lead, 20 feet. Spall with no penetration.
    - d. Glass Color: Clear.
  3. U-Factor: .84
  4. Solar Heat Gain Coefficient: .73

5. Overall Visible Light Transmittance: .82
  6. Provide Test Report for ASTM F1233 Class 1.4 by Third Party Independent Laboratory.
  7. Provide Test Report for 5-aa1 by Third Party Independent Laboratory.
  8. Provide Test Report for HP White-TP-0500.03 Level A for Bullet Resistance.
  9. Refer To Manufacturers Installation Instructions.
- D. SG2: Monolithic Security, Non-insulated Glazing: Childgard-2118 Security Glazing or comparable product approved by Architect. Refer to Section 08 88 53.
1. Overall Unit Thickness: 9/16 inch.
  2. Interior Pane: Childgard-2118 Security Glazing by Global Security Glazing or other CGH Inc. Company
    - b. Forced Entry Resistance: ASTM F1233 Class 1.4
    - c. Forced Entry Resistance: 5-aa1 rated for a minimum of 16 minutes
    - d. Bullet Resistance: HP White-TP-0500.03 Level A
      1. .38 special handgun, 3 shots in an 8" circle, 158 grain lead, 20 feet. Spall with no penetration.
    - e. Glass Color: Clear.
  3. U-Factor: .84
  4. Solar Heat Gain Coefficient: .73
  5. Overall Visible Light Transmittance: .82
  6. Provide Test Report for ASTM F1233 Class 1.4 by Third Party Independent Laboratory.
  7. Provide Test Report for 5-aa1 by Third Party Independent Laboratory.
  8. Provide Test Report for HP White-TP-0500.03 Level A for Bullet Resistance.
  9. Refer To Manufacturers Installation Instructions.
- E. SG3: Monolithic Security, Non-insulated Glazing: Childgard-2118 Security Glazing or comparable product approved by Architect. Refer to Section 08 88 53.
1. Overall Unit Thickness: 3/8 inch.
  2. Interior Pane: Childgard-2118 Security Glazing by Global Security Glazing or other CGH Inc. Company
    - a. Forced Entry Resistance: ASTM F1233 Class 1.4
    - b. Forced Entry Resistance: 5-aa1 rated for a minimum of 16 minutes
    - c. Bullet Resistance: HP White-TP-0500.03 Level A
      1. .38 special handgun, 3 shots in an 8" circle, 158 grain lead, 20 feet. Spall with no penetration.
    - d. Glass Color: Clear.
  3. U-Factor: .84
  4. Solar Heat Gain Coefficient: .73
  5. Overall Visible Light Transmittance: .82
  6. Provide Test Report for ASTM F1233 Class 1.4 by Third Party Independent Laboratory.
  7. Provide Test Report for 5-aa1 by Third Party Independent Laboratory.
  8. Provide Test Report for HP White-TP-0500.03 Level A for Bullet Resistance.
  9. Refer To Manufacturers Installation Instructions.

**END OF SECTION 08 80 00**

## **SECTION 08 83 00 - MIRRORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Glass mirrors with Safety Film Backing.
  - 2. Accessories necessary for a complete installation.
- B. Related Work:
  - 1. Section 08 80 00 - Glazing.

#### **1.3 DEFINITIONS**

- A. Deterioration of Mirrors: Defects developed from normal use attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to mirror manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Provide mirrors that will not fail under normal usage. Failure includes glass breakage and deterioration attributable to defective manufacture, fabrication, and installation.

#### **1.5 SUBMITTALS**

- A. Product Data: Technical data for mirror units including description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality control provisions.
- B. Shop Drawings: Submit mirror elevations, edge details, mirror hardware, and attachments to other Work.

#### **1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
  - 2. Glazing Publications: Comply with published recommendations:
    - a. *GANA Glazing Manual* unless more stringent requirements are indicated.
    - b. *GANA Mirror Division Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors.*

3. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
- B. Installer Qualifications: Experienced installer having minimum 5 years documented experience and has completed mirror glazing similar in material, design, and extent to that indicated.
- C. Source Limitations for Mirrors: Obtain mirrors from one source for each type of mirror indicated.
- D. Source Limitations for Mirror Glazing Accessories: Obtain mirror glazing accessories from one source for each type of accessory indicated.
- E. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mirrors according to mirror manufacturer's written instructions and necessary to prevent damage to mirrors from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

#### **1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

#### **1.9 WARRANTY**

- A. Warranty: Warranty made out to Owner and signed by mirror manufacturer agreeing to replace mirrors that deteriorate, f.o.b. the nearest shipping point to site, within specified warranty period:
  1. Warranty Period: Five years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Manufacturers: Subject to compliance with requirements, provide mirrors by one of the following:
  1. Guardian Industries Corp.
  2. Trulite Glass & Aluminum Solutions; (713) 747-5430.
  3. Virginia Mirror Company, Inc.;
  4. VVP America, Inc.; Binswanger Mirror Products.
  5. Walker Glass Co., Ltd.
- B. Clear Glass Mirrors: Annealed monolithic glass, ASTM C 1503, Mirror Select Quality, clear float glass with a minimum 91 percent visible light transmission.
  1. Nominal Thickness: 6.0 mm.
- C. Setting Blocks: Elastomeric material with Type A Shore durometer hardness of 85, plus or minus 5.



- D. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- E. Mirror Mastic: Adhesive setting compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed. Provide product recommended by mirror manufacturer.
- F. Safety Backing: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.
  - 1. Provide at Fine Arts
- G. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
  - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 inch and 7/8 inch (9.5 mm and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
      - 2) Sommer & Maca Industries, Inc.; Aluminum Shallow Nose "J" Moulding Lower Bar.
  - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
      - 2) Sommer & Maca Industries, Inc.; Aluminum Deep Nose "J" Moulding Upper Bar.
  - 3. Finish: Clear.
- H. Top and Bottom Clips: As indicated.
- I. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- J. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead shield expansion bolt devices for drilled in place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

## 2.2 FABRICATION

- A. Mirror Sizes: To suit conditions, cut mirrors to final sizes and shapes.
- B. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.
- C. Mirror Edge Treatment:
  - 1. Cutting and Polishing: Flat edges where the clean cut square edge of the glass is flat and surface edges are slightly arched. After grinding the arched edges, polish edges to a high gloss surface where the surface reflectivity is similar in appearance to the major surface of the glass.
  - 2. Edge Sealing: Immediately after cutting to final sizes, and applying edge treatment, factory seal edges of mirrors with edge sealer to prevent chemical or atmospheric penetration of glass coating.

- D. Film Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.
- E. Miters within the J trim are to be cleanly and smoothly welded.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, over which mirrors are to be mounted for compliance with installation tolerances, substrate preparation, and conditions affecting performance. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers. Proceed with mirror installation after unsatisfactory conditions have been corrected and surfaces are dry.

#### **3.2 PREPARATION**

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating surfaces with mastic manufacturer's special bond coating where applicable.

#### **3.3 INSTALLATION**

- A. Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images. Provide minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- B. Wall Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
  - 1. For metal or plastic clips, place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges.
  - 2. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
  - 3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips to be symmetrically placed and evenly spaced.
    - a. Fabricate bottom trim in single lengths to fit and cover bottom edges of mirrors. Locate top clips so they are symmetrically placed and evenly spaced.
  - 4. Mastic: Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
    - a. Apply mastic in vertical beads or mounds to the wall, not to the mirror back to avoid potential damage caused by mastic applicator tools, in compliance with mastic manufacturer's written instructions to allow air circulation between back of mirrors and face of mounting surface.
    - b. Make each vertical bead approximately 1/2 inch in width with minimum of one bead for every square foot of mirror.
    - c. Make each mound approximately 1-1/2 inch in diameter with a minimum of one mound for every square foot of mirror.
    - d. Do not apply mastic within 6 inches of the mirror edges to prevent squeeze out. Place beads or mounds leaving a space between mirror and wall. After mastic is applied, align mirrors and press into place. Spread each vertical bead to

approximately 2 inches in width and spread each mound to a pat approximately 3-1/2 inch in diameter after pressing mirror into place.

- e. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

#### **3.4 CLEANING AND PROTECTION**

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations. Do not permit edges of mirrors to be exposed to standing water. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- B. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

**END OF SECTION 08 83 00**

## **SECTION 08 87 23 – SAFETY AND SECURITY FILM**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.02 SUMMARY**

- A. Section Includes: Laminated security glazing, forced entry resistant glazing.

#### **1.03 REFERENCES**

1. ANSI Z97.1 - American National Standard for Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
2. ASTM C1036 - Standard Specification for Flat Glass.
3. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass -- Kind HS, Kind FT Coated and Uncoated Glass.
4. ASTM F1233 – Standard Testing Method for Security Glazing Materials and Systems.
  - a) Class 1.3 to 6 minutes to 47 seconds.
5. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

#### **1.04 SYSTEM DESCRIPTION**

- A. Design Requirements
  1. Provide glazing systems capable of withstanding normal thermal movements, wind loads and impact loads, without failure, including loss due to defective manufacture, fabrication and installation; deterioration of glazing materials; and other defects in construction.
  2. Provide glass products in the thicknesses and strengths (annealed or heat-treated) required to meet or exceed the following criteria based on project loads and in-service conditions per ASTM E1300.
    - a. Minimum thickness of annealed or heat-treated glass products is selected, so the worst-case probability of failure does not exceed the following:
      - 1) 8 breaks per 1000 for glass installed vertically or not over 15 degrees from the vertical plane and under wind action.
      - 2) 1 break per 1000 for glass installed 15 degrees or more from the vertical plane and under action of wind and/or snow.

#### **1.05 SUBMITTALS**

- A. Submit 12-inch (305mm) square samples of each type of glass indicated (except clear monolithic glass products), and 12-inch (305mm) long samples of each color required (except black) for each type of sealant or gasket exposed to view.
- B. Submit manufacturer's product data for each security glazing type, including type of materials, thickness, method of test, test performance report and glazing and cleaning instructions.
- C. Glazing contractor shall obtain compatibility and adhesion test reports from sealant manufacturer, indicating that glazing materials were tested for compatibility and adhesion with glazing sealant, as well as other glazing materials including insulating units.
- D. Glazing Contractor shall provide test reports showing that the glass meets the requirements of any security test reports specified on drawings.

## **1.06 QUALITY ASSURANCE**

- A. Manufacturers Qualifications: Firm experienced in manufacturing security glass, types as specified, with a minimum documented 5 years of successful in-service performance.
- B. Installers Qualification: Glazing film systems shall be installed by an experienced installer certified, licensed, or otherwise qualified by film manufacturer as having the necessary experience, staff, and training to installed manufacturer's products according to specified requirements.
- C. Testing Agencies: Subject to compliance with requirements, acceptable testing agencies are:
  - 1. HP White Laboratories, Inc.
  - 2. Warnock-Hersey International
  - 3. Wiss, Janney, Elstner Associates, Inc.
  - 4. Underwriters Laboratories, Inc.
- D. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or referenced standards.
  - 1. GANA Publications
  - 2. AAMA Publications
- E. Single-source fabrication responsibility: All fabricated glass shall be processed and supplied by a single fabricator.

## **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Comply with manufacturer's instruction for receiving, handling, storing and protecting glass & glazing materials.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass and damage/deterioration to coating on glass.

## **1.08 PROJECT / SITE CONDITIONS**

- A. Environmental Requirements: Installation of glass products at ambient air temperature below 40 degrees F (4.4 degrees C) is prohibited.
- B. Field Measurements: When construction schedule permits, verify field measurements with drawing dimensions prior to fabrication of glass products.

## **1.09 WARRANTY**

- A. Provide written Fifteen (15) years warranty from date of manufacture for laminated security glass. Warranty covers deterioration due to normal conditions of use and not to handling installing, protecting and maintaining practices contrary to glass manufacturer's published instructions.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Basis of Design: 23 mil Shooter Attach Security Film as manufactured by Armored One, LLC., or comparable product approved by Architect.
- B. Impact Protection Adhesive: Subject to compliance with requirements, provide products from Dow Corning, or a comparable product by one of the following:
  - 2. Comparable Products and Systems, submitted and approved prior to bid. Submitted systems must have documented test performance meeting the specified criteria with the submitted window films

**2.1 SAFETY AND SECURITY WINDOW FILM**

- A. Provide film products from a single manufacturer.
- B. Use Silver Reflective or Neutral Tinted films to match existing conditions where solar control films are currently present. Where no existing tinted or reflective films are present, use Clear Film. For interior applications use Clear Film.
- C. Type 1 – Safety and Security Window Film :

Manuf.	Film Series	Product Name	Thick.	Light Trans.	Tensile Strength (psi)	Break Strength (lbs/in)
Armored One	Shooter Attack	Certified 23 Mil. Film	23 mil	87%	35,000	640

**2.3 IMPACT ATTACHMENT SYSTEMS**

- A. General: Subject to compliance with testing and performance requirements, provide one of the following perimeter attachment systems.
  - 1. Wet-glaze: The security film is applied to the glass in a fashion whereby the window glazing gaskets are trimmed and the film's edges are inserted behind the window frame. A bead of Dow Corning 995® structural silicone is then applied flush against the frame to overlap the security film and take the place of the original gasket.
  - 2. A minimum bead of 3/4" (.75") overlapping the exposed edge of the security film, and 3/4" (.75") overlapping the window frame/glazing system shall be used on all installations.
  - 3. Structural adhesive to be color matched whenever possible, as allowed by availability from structural sealant manufacturer. Color matched is described as matching the color of the existing glazing bead/gasket.
  - 4. Doors with Glass: Film applied glass edge-to-glass edge on interior of glass and Dow 995 applied under caps/stops to adhere film-to-frame-to-cap/stop.

**2.4 IMPACT PROTECTION ADHESIVE:**

- A. Dow Corning 995 Silicone Structural Glazing Sealant: Weatherable, UV-resistant, moisture curable structural sealant wet glaze
  - 1. Color: Black.
  - 2. Material Properties (as supplied):
    - a. Typical Cure Time: 7-14 days (25 degrees C, 50% RH)
    - b. Full Adhesion: 14 - 21 days
    - c. Tack-Free Time (ASTM D 5895): 65 minutes (25 degrees C, 50% RH)
    - d. Flow, Sag or Slump (ASTM D 2202): 0.1 inches

- e. Specific Gravity: 1.3
  - f. Working Time: 10 - 20 minutes (25 degrees C, 50% RH)
  - g. VOC Content: 30 g/L
3. Material Properties (as cured - 21 days at 25 degrees C, 50% RH):
- a. Ultimate Tensile Strength (ASTM D412): 350 psi (2.62 MPa)
  - b. Ultimate Elongation (ASTM D412): 525 psi
  - c. Durometer Hardness, Shore A (ASTM D2240): 40 points
  - d. Tear Strength, Die B (ASTM D624): 49 ppi
4. Uniformity: Product shall have uniform consistency and appearance, with no clumping.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Site Verification and Conditions
- 1. Verify that site conditions are acceptable for installation of the glass.
  - 2. Verify openings for glazing are correctly sized and within tolerance.
  - 3. Verify that the minimum required face and edge clearances are being followed.
  - 4. Do not proceed with glazing until unsatisfactory conditions have been corrected.

#### **3.02 PREPARATION**

- A. Protection
- 1. Handle and store product according to manufacturers' recommendations.
- B. Surface Preparation
- 1. Clean and prepare glazing channels and other framing members to receive glass.
  - 2. Remove coatings and other harmful materials that will prevent glass and glazing installation required to comply with performance criteria specified.

#### **3.03 INSTALLATION**

- A. Install products using the recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".
- B. Install glass in prepared glazing channels and other framing members.
- C. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.
- D. Distribute the weight of the glass unit along the edge rather than at the corner.
- E. Comply with manufacturer's and referenced industry recommendations on expansion joints and anchors, accommodating thermal movement, glass openings, use of setting blocks, edge, face and bite clearances, use of glass spacers, edge blocks and installation of weep systems.
- F. Protect glass from edge damage during handling and installation.
- G. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

#### **3.04 CLEANING**

- A. Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.
- B. Do not use scrapers or other metal tools to clean glass.
- C. Provide maintenance, cleaning and replacement instructions to Owner.

**END OF SECTION 08 87 23**



## **SECTION 08 91 19 - FIXED LOUVERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Fixed, extruded aluminum and formed metal louvers.
  - 2. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind Driven Rain Resistant Louver: Louver that provides specified wind driven rain performance determined by testing according to AMCA 500-L.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  - 2. Show mullion profiles and locations.
  - 3. Windstorm: Design loads as indicated on drawings.
- C. Samples: Submit for units with factory applied color finishes.

#### **1.5 QUALITY ASSURANCE**

- A. Delegated Design Submittal: For louvers indicated to comply with structural [ **and seismic** ] performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

- C. Windborne debris impact resistance test reports.
- D. Regulatory Requirements:
  - 1. SMACNA Standard: Comply with recommendations in *SMACNA Architectural Sheet Metal Manual* for fabrication, construction details, and installation procedures.
  - 2. Welding: Qualify procedures and personnel according to the following:
    - a. AWS D1.2/D1.2M Structural Welding Code - Aluminum.
- E. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory applied color finish.

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.7 WARRANTY

- A. Warrant the work specified herein for 20 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to:
  - 1. Fading, corrosion, or other finish deterioration.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, No. 4 finish, with grain running parallel to length of blades and frame members..
- E. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use tamper resistant screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - 3. For fastening galvanized steel, use hot dip galvanized steel or 300 series stainless steel fasteners.
  - 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
  - 5. For color finished louvers, use fasteners with heads that match color of louvers.
- F. Postinstalled Fasteners for Concrete and Masonry: Torque controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.2 FIXED, EXTRUDED ALUMINUM LOUVERS

- A. Horizontal Continuous Line, Drainable Blade Louver: 90 degree, flat face blades.
1. Basis of Design: Model LE-54 as manufactured by American Warming and Ventilating (AWV). Other manufacturers are subject to compliance with requirements, provide products of one of the following:
    - a. Aiolite Company, LLC (The).
    - b. Arrow United Industries.
    - c. Construction Specialties, Inc.
    - d. Greenheck Fan Corporation.
    - e. Ruskin Company; Tomkins PLC.
  2. Louver Blade: 0.060 inch thick, extruded aluminum, ASTM B 209, Alloy 6063-T5.
  3. Frame: 5 inch deep channel, 0.078 inch thick extruded aluminum, ASTM B209, Alloy 6063-T5.
  4. Screen: 1/2 inch removable expanded aluminum bird screen, located on interior.
  5. Panel Size: Refer to the Drawings.
  6. Blade Spacing: 2 inch.
  7. Blade Orientation: Horizontal.
  8. Pressure Drop: 0.31 in w.g. at 1250 fpm and 8850 scfm.
  9. Water Penetration: 1250 fpm.

## 2.3 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field bolted assembly with close fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade spacing pattern unless horizontal mullions are indicated.
  2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close fitting blade splices designed to permit expansion and contraction.
  2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
  3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling

limitations, provide interlocking split mullions designed to permit expansion and contraction.

4. Exterior Corners: Prefabricated corner units with mitered blades with concealed close fitting splices and with fully recessed mullions at corners.

- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## **2.4 FINSHES**

- A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Aluminum Finishes:
  1. Finish louvers after assembly.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 PREPARATION**

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### **3.3 INSTALLATION**

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent Work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective Work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 for sealants applied during louver installation.

**3.4 ADJUSTING AND CLEANING**

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective Work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.

**END OF SECTION 08 91 19**

## **SECTION 09 05 00 - COMMON WORK RESULTS FOR FINISHES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Substrate testing.
  - 2. Stone thresholds.
  - 3. Waterproof membranes.
- B. Related Sections:
  - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete design, underslab vapor barrier and finished concrete surface required to accept flooring adhesive and finish flooring system.
  - 2. Section 03 54 00 - Cast Underlayment: Leveling of existing concrete slabs.
  - 3. Section 05 77 00 - Decorative Extruded Metal: Extruded metal transitions and trim.
  - 4. Section 06 10 00 - Rough Carpentry: Wood-based panel underlayment required to accept installation of finish flooring systems.
  - 5. Section 06 16 00 - Sheathing: For proper wood-based panel underlayment required to accept installation of finish flooring systems.
  - 6. Section 09 65 13 - Resilient Base and Accessories.
  - 7. Section 09 65 19 - Resilient Tile Flooring.
  - 8. Section 09 68 00 - Carpeting.

#### **1.3 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- C. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007 - Not Active.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2021.
- F. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- G. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.
- H. ASTM F1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring; 2021.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2022.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- K. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.

#### **1.4 DEFINITIONS**

- A. Refer to Section 01 42 16 - Definitions for the following terms:
  - 1. Adhesives.

2. Leadership in Energy and Environmental Design (LEED).
3. Volatile Organic Compound (VOC)

## 1.5 SUBMITTALS

- A. Product Data:
  1. Submit manufacturer's printed descriptions of materials, components and systems; performance criteria; use limitations; preparation instructions and recommendations; storage and handling requirements and recommendations; and installation methods.
- B. Certificates:
  1. Submit with manufacturer's signature certifying that each product and/or system meets the requirements of the performance characteristics, physical criteria, and applicable standards specified.
    - a. Provide Master Grade Certificate as specified in ANSI A137.1.
- C. Test and Evaluation Reports:
  1. Submit certified test results by a recognized testing laboratory in accordance with specified test methods for each product and/or system indicating physical, chemical and performance characteristics.
- D. Samples:
  1. Submit samples showing full range of color and texture variations expected.
  2. Full size units of each type and composition of tile and for each color and finish required.
  3. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
  4. Waterproof membrane in 6 inch by 6 inch (150 mm by 150 mm) sample.
  5. Thresholds in 6 inch (150 mm) lengths.
- E. Closeout Submittals:
  1. Operation and Maintenance Data: Including, but not limited to, methods for maintaining installed products and precautions against cleaning materials with methods detrimental to finishes and performance.
  2. Executed Warranty Documentation: Manufacturers' material warranties and installers workmanship warranty.
  3. Record Documents: Drawings, Specifications, Product Data.

## 1.6 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
  1. Section 03 30 00 - Cast-In-Place Concrete.
  2. Section 03 54 00 - Cast Underlayment.
  3. Section 09 30 13 - Ceramic Tiling.
  4. Section 09 30 16 - Quarry Tiling.
  5. Section 09 30 23 - Glass Tiling.
  6. Section 09 30 33 - Stone Tiling.
  7. Section 09 65 19 - Resilient Tile Flooring.
  8. Section 09 68 00 - Carpeting.
- B. Static Coefficient of Friction (SCOF): For tile installed on walkway surfaces which are not anticipated to be wet, provide products with values determined by testing identical products per ASTM C1028:
  1. Level Surfaces: Minimum 0.6.
  2. Ramp Surfaces: Minimum 0.8.
- C. Dynamic Coefficient of Friction (DCOF): Per ANSI A137.1 Section 9.6 DCOF AcuTest:
  1. Wet Level Surfaces: Minimum 0.42 unless noted otherwise.

## 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Surface Burning Characteristics: ASTM E84; identify products with appropriate markings of applicable testing agency.
    - a. Flame Spread Index: 25 or less.
    - b. Smoke Developed Index: 450 or less.
  - 2. Accessibility Requirements: Comply with applicable requirements.
    - a. ADA Standards.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
- B. Qualifications:
  - 1. Installer / Applicator: Perform installation with skilled, experienced and trained workmen supervised by trained personnel who shall have a minimum three (3) years successful experience in installations of similar size and scope.
  - 2. Testing Agency: An independent testing agency with the experience and capability to conduct the testing indicated, meeting requirements of ISO/IEC 17025 or ASTM E329 and ASTM E699.
- C. Source Limitations:
  - 1. Obtain spray-applied adhesive through one source from a single manufacturer.
  - 2. Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
  - 3. Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
    - a. Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
      - 1) Stone thresholds.
      - 2) Waterproofing.
      - 3) Joint sealants.
      - 4) Cementitious backer units.
      - 5) Metal edge strips.
- D. Sustainability Standards and Certifications:
  - 1. Adhesive and Sealant VOC Limits: According to South Coast Air Quality Management District Rule 1168 and GS-36 for aerosols.
  - 2. VOC Limits: As tested using U.S. EPA Reference Test Method 24 and as defined by
    - a. South Coast Air Quality Management District Rules: In areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur.
      - 1) SCAQMD Rule 1168, Adhesive and Sealant Applications
    - b. California Air Resources Board: For areas where freeze/thaw conditions do exist or direct exposure to moisture can occur.
      - 1) CARB for containers 16 oz. or less.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of each type of floor tile installation.
  - 2. Build mockup of each type of wall tile installation.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Handling per manufacturer's recommendations, Section 01 60 00 - Product Requirements, and as follows:
  - 1. Delivery and Acceptance Requirements



- a. Deliver materials to Project site in an undamaged condition, in original, unopened and undamaged packages or containers bearing manufacturer's intact label, names, brand names, types and thicknesses of contents, and proper handling, storing, unpacking, protecting, and installation instructions, as warranted.
    - 1) Comply with requirements in ANSI A137.1 for labeling tile packages.
  - b. Inspect shipped materials on delivery to ensure compliance with requirements of Contract Documents and to ensure that products are undamaged and properly protected. Reject damaged goods and accept properly ordered, protected and undamaged goods.
2. Storage and Handling Requirements
    - a. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.
    - b. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.
    - c. Store adhesive materials in a dry, temperature-controlled interior area at 65-80 deg F (18-27 deg C). Protect materials from damage from improper handling, exposure to temperature extremes, and the action of other trades.
  3. Packaging Waste Management
    - a. Request in writing that manufacturers, fabricators, suppliers and shippers provide least amount of packaging that adequately and properly protects, supports and contains the items shipped, and is reusable, returnable or recyclable.

#### **1.9 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

#### **1.10 EXTRA STOCK**

- A. Refer to related sections for extra stock requirements.

#### **1.11 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 - Project Management and Coordination.

#### **1.12 WARRANTY**

- A. Refer to related sections for specific product warranty requirements.

### **PART 2 PRODUCTS**

#### **2.1 NOT USED**

### **PART 3 EXECUTION**

#### **3.1 FIELD CONDITIONS**

- A. Conditions and Measurements: Visit jobsite to verify installation conditions and floor measurements.
- B. Ambient Conditions per manufacturer's written recommendations, and as follows:
  1. New concrete slabs shall be flat, clean and dry meeting all moisture tests passing manufacturer's written requirements.

2. Environmental Limitations: Maintain temperature and relative humidity per manufacturer's recommendations.
  - a. Maintain space, substrate temperatures, and RH for time prior to, during and after installation as recommended.
3. Acclimate floor finish materials into spaces they will be installed a minimum 48 hours in advance of installation.
  - a. Do not install until all floor finish materials are same temperature as space where they are to be installed.

### **3.2 EXAMINATION - GENERAL**

- A. Contractor shall examine preparatory work by others, with Installer/Applicator present, for compliance with requirements affecting Work performance.
  1. Contractor shall notify Architect of any issues which would affect installation of finish. Absence of such notification shall constitute acceptance of responsibility by Contractor.
- B. Verify that field measurements, surfaces, substrates, structural support, tolerances, levelness, plumbness, temperature, humidity, moisture content level, cleanliness, and other conditions are as required by the manufacturer, and ready to receive Work.

### **3.3 EXAMINATION - FLOORING**

- A. Verify that concrete floors to receive resilient flooring meet ASTM F710 requirements and are flat as recommended by floor finish manufacturer.
- B. Verify that wood and panel type underlayment substrates to receive resilient flooring meet ASTM F1482 requirements and are flat as recommended by floor finish manufacturer.
- C. Test substrates as required by manufacturer to verify proper conditions.
  1. Portland-Cement Concrete:
    - a. Perform moisture testing to verify that concrete substrate is sound and dry. Both of the following tests are required:
      - 1) Perform relative humidity (RH) test using in situ probes per ASTM F2170 . Proceed with installation only after each substrate measures a maximum 75 percent RH.
      - 2) Perform anhydrous calcium chloride testing per ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 7 lbs of water/1000 sf (3.18 kg of water/92.9m<sup>2</sup>) in 24 hours.
    - b. Perform alkalinity testing to verify pH level is 11 or below per ASTM F710.
    - c. Perform bond testing per ASTM F710 to determine compatibility of adhesive to concrete substrate.
  2. Wood Underlayment: Shall be dry, clean, structurally sound, well nailed and/or glued, free of voids and with joints that do not exceed 1/16 inch (1.6mm) per floor finish manufacturer's installation instructions.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.
    - a. Commencement of work related to this Section will constitute acceptance of conditions.

### **3.4 INSTALLATION - GENERAL**

- A. Lay out tiling so that no tile is cut to less than 1/2 of its full size in either direction.
- B. Slope tile within 3 foot diameter of a floor drain, unless otherwise noted.
- C. Form internal angles square.

### **3.5 INSTALLATION - STONE THRESHOLDS**

- A. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.

### **3.6 FIELD QUALITY CONTROL**

- A. Site Tests and Inspections:

1. Inspect floor finish system installation for non-conforming Work including, but not limited to, the following:
  - a. Lack of adequate adhesion.
  - b. Adhesive overspray.
    - 1) Clean off water-based adhesive overspray with a damp cloth.
  - c. Improper substrate preparation as indicated by:
    - 1) Air blisters.
    - 2) Buckling.
    - 3) Cracks.

**3.7 CLEANING**

- A. Clean finishes as required and in accordance with manufacturer's recommendations.

**3.8 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 77 00 - Closeout Procedures.

**END OF SECTION 09 05 00**

## **SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Gypsum Board.
  2. Partition Framing Systems.
  3. Exterior Gypsum Board for Ceilings and Soffits.
  4. Reinforced Gypsum Board Sheathing (Tile Backer Board).
  5. Cementitious Backer Units.
  6. Ceiling Suspension Systems.
  7. Accessories necessary for a complete installation.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
  1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
  2. Ground Floor Lobbies: 1/120 at 15 psf.
  3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
  4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
  5. Typical Partitions: 1/240 at 5 psf.
  6. Other Partitions: 1/240 at 5 psf.
    - a. Maximum Deflection:
      - 1) L/240 at 5 lbf per sq. ft.
      - 2) L/120 at 5 lbf per sq. ft.
      - 3) L/120 at 7.5 lbf per sq. ft.
      - 4) L/120 at 10 lbf per sq. ft.
- B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.
  1. Sustainable Design Submittals:
    - a. Product Data: For recycled content, indicating post-consumer and pre-consumer recycled content.
    - b. Product Data: For adhesives, indicating VOC content.

- c. Laboratory Certificates or Validations: For adhesives, indicating compliance with requirements for low-emitting materials.
  - d. Certified Wood: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
- B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- 1. Submit joint layout. Determine any anticipated areas of cracking or diminished resistance of cracking.
- C. Samples:
- 1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
  - 2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for Work.
- D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.
- E. Evaluation Reports: ICC-ES reports for steel studs and runners and firestop tracks.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
- 1. Comply with applicable requirements of IBC for interior finishes.
  - 2. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 for gypsum board or manufacturer's written instructions, whichever are more stringent.
- 1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

- D. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## 1.8 WARRANTY

- A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. In addition, provide warranty from the manufacturer for the following products:
  - 1. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six (6) months.
  - 2. Abuse Resistant Panel warranty against manufacturing defects for three (3) years.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers: Listed manufactures whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Steel Studs and Tracks:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) ClarkDietrich; (888) 437-3244.
      - 2) CEMCO; California Expanded Metal Products Co.; (800) 775-2362.
      - 3) MBA Building Supplies; (888) 248-8076.
      - 4) Mill Steel Framing; (800) 247-6455.
      - 5) MRI Steel Framing, LLC.; (630) 616-1850.
      - 6) Phillips Manufacturing Co.; (800) 822-5055.
      - 7) Steel Network, Inc. (The); (888) 474-4876.
      - 8) Telling Industries; (866) 372-6384.
  - 2. Ceiling Grid:
    - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; 640-C.
    - c. CertainTeed Corporation.
    - d. USG Corporation; Drywall Suspension System.
  - 3. Gypsum Board:
    - a. American Gypsum Co.
    - b. Certainteed Corporation.
    - c. Georgia Pacific.
    - d. National Gypsum Company.
    - e. USG Corporation.
  - 4. Tile Backer Board:
    - a. Gold Bond eXP; National Gypsum.
    - b. Securock; United States Gypsum Company.
  - 5. Cementitious Board:
    - a. Durock Brand Cement Board; United States Gypsum Company.

- b. National Gypsum.
- B. Framing Members: ASTM C 754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
1. Steel Sheet Components: Comply with AISI S220 requirements for metal.
  2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot dip galvanized.
- C. Steel Framing Components: ASTM C 754 for conditions indicated; hot dip galvanize complying with ASTM A 653M Z180.
1. Steel Studs and Runners: AISI S220, 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
  2. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
  3. Cold Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
  4. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
  5. Hat Shaped, Rigid Furring Channels: ASTM C 645; 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
  6. Resilient Furring Channels: 1/2 inch (12.7mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
  7. Cold Rolled Furring Channels: 0.0538 inch (1.37mm) bare steel thickness, with minimum 1/2 inch (12.7mm) wide flanges.
    - a. Depth: Indicated on Drawings.
    - b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
    - c. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59mm) diameter wire, or double strand of 0.0475 inch (1.21mm) diameter wire.
  8. Z Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
  9. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
  10. Slip Type Head Joints: Where indicated, provide one of the following:
    - a. Single Long Leg Runner System: ASTM C 645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
    - b. Double Runner System: ASTM C 645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
    - c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
      - 1) ClarkDietrich; MaxTrak Slotted Deflection Track.
      - 2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
      - 3) Superior Metal Trim; Superior Flex Track System (SFT).
  11. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
    - a. ClarkDietrich; BlazeFrame Fire Stop Deflection.
    - b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.

- c. Grace Construction Products; FlameSafe FlowTrak System.
  - d. Metal-Lite, Inc.; The System.
  - e. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series as applicable.
- D. Ceiling Suspension Components:
1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire.
  2. Hanger Attachments to Concrete:
    - a. Anchors: Postinstalled, chemical anchor or postinstalled, expansion anchor fabricated from corrosion resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - b. Powder Actuated Fasteners: Suitable for application indicated, fabricated from corrosion resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
  3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
  4. Carrying Channels: Cold rolled, commercial steel sheet with base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
  5. Furring Channels (Furring Members):
    - a. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
    - b. Steel Studs: ASTM C 645; minimum base metal thickness of 0.0312 inch (0.79 mm); Depth indicated on Drawings.
    - c. Hat Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep; Minimum base metal thickness of 0.0312 inch (0.79 mm).
  6. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission. Configuration: Hat shaped.
  7. Grid Suspension System for Ceilings: ASTM C 645, direct hung system composed of main beams and cross furring members that interlock.
- E. Impact Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
1. Use Impact Resistant Gypsum Board Throughout.
  2. Core and Thickness: 5/8 inch (15.9 mm), Type X.
  3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
  4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
  5. Soft Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
  6. Hard Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements according to test in Annex A1.
  7. Long Edges: Tapered.
  8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- F. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C 1278/C 1278M, standard edges. Areas of Restrooms, EDFs, and other wet walls with tile board as well as bottom 3-1/2 inch RIP are only allowed use of cementitious board.
1. Core and Thickness: 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) to match conditions, Type X.
  2. Long Edge: Tapered.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.



- G. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325.
  - 1. Thickness: 5/8 inch (15.9 mm) to match conditions.
  - 2. Long Edges: Standard.
  - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
  
- H. Exterior Trim: ASTM C 1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
  - 1. Shapes:
    - a. Cornerbead.
    - b. LC Bead: J shaped; exposed long flange receives joint compound.
    - c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.
  
- I. Interior Trim: ASTM C 1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
  - 1. Poly Vinyl Chloride (PVC) compound meeting the requirements of ASTM C1047. ASTM D3678, ASTM D3679, and ASTM D4216.
  - 2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC Bead: J shaped; exposed long flange receives joint compound.
    - d. L Bead: L shaped; exposed long flange receives joint compound.
    - e. U Bead: J shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
  - 3. Extruded Aluminum Reveal\_Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fry Reglet Corporation; (800) 237-9773.
    - b. Gordon, Inc.; (888) 877-8746.
    - c. Pittcon Industries; (301) 927-1000.
  
- J. Continuous Corner: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer. Provide Pittcon Softforms SO-HSE-90 or Schluter.
  - 1. Basis of Design: Pittcon Softforms SO-HSE-90; Subject to compliance with requirements, provide basis of design or comparable by one of the following:
    - a. Fry Reglet Corporation; (800) 237-9773.
    - b. Pittcon Industries; (301) 927-1000.
    - c. Schluter; (888) 472-4588.
  
- K. Joint Treatment: ASTM C 475/C 475M.
  - 1. Joint Tape:
    - a. Exterior Gypsum Soffit Board: Paper.
    - b. Joint Tape, Interior Gypsum Board: Paper.
  - 2. Joint Compound:
    - a. Gypsum Board: Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
      - 1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
        - a) Use setting type compound for installing paper faced metal trim accessories.
      - 2) Fill Coat: For second coat, use setting type, sandable topping compound.
      - 3) Finish Coat: For third coat, use setting type, sandable topping compound.

- 4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.
  - b. Cementitious Units: Recommended by backer unit manufacturer.
  - c. Tile Backing Panels: Recommended by backer unit manufacturer.
  - d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
  - e. ↓
- L. Auxiliary Gypsum Materials: Comply with referenced installation standards and manufacturer's written recommendations.
  - 1. Steel Drill Screws: ASTM C 1002, use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
  - 2. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
    - a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  - 3. Control Joints: Metal (USG #093 / Dietrich 093 Control Joint) type with 1/4 inch open joint, perforated flanges for floating in place.
  - 4. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti, Inc.;(800) 879-8000.
      - 2) Pecora Corporation; (800) 523-6688.
      - 3) Specified Technologies, Inc.; (800) 992-1180.
      - 4) United States Gypsum Company; (800) 950-3839.
  - 5. Every gypsum board wall must have a 3-1/2 inch trim of Generically, cementitious board at base of partition

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

#### **3.3 INSTALLATION**

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

- B. Gypsum Board Assemblies: Comply with requirements in ASTM C 840 applicable to framing installation.
- C. Control joints shall be located 30 feet-0 inches on center maximum and along building expansion joints, unless noted otherwise on drawings. Locations shall be reviewed with Architect prior to final placement.
- D. Suspension System: Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
  - 1. Suspend hangers from building structure:
    - a. Install hangers plumb and free from contact with insulation or objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
    - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
    - c. Do not attach hangers to steel roof deck.
    - d. Do not attach hangers to permanent metal forms. Furnish cast in place hanger inserts that extend through forms.
    - e. Do not attach hangers to rolled in hanger tabs of composite steel floor deck.
    - f. Do not connect or suspend steel framing from ducts, pipes, or conduit.
  - 2. Fire Resistance Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track. Do not install rivets.
- F. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
  - 1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
  - 2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
    - a. Acoustical Sealant: Install continuous ribbon of acoustical sealant under floor track. Refer to Section 07 92 00.
    - b. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
      - 1) Install two studs at each jamb, unless otherwise indicated.
      - 2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
      - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
    - c. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- G. Gypsum Panels: Comply with ASTM C 840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
  2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
  3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
  4. Form control and expansion joints with space between edges of adjoining gypsum panels.
  5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
    - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
    - b. Fit gypsum panels around ducts, pipes, and conduits.
    - c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.
  6. Isolate perimeter of gypsum board applied to nonload bearing partitions at structural abutments and floors. Provide 1/4 inch to 1/2 inch (6.4mm to 12.7mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
  7. Acoustical Sealant: Install continuous ribbon of acoustical sealant under floor track. Refer to Section 07 92 00.
  8. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. Gypsum Board: Install interior gypsum board where indicated on drawings.
1. Single Layer Application:
    - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
    - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
  2. Multilayer Application:
    - a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
    - b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

- c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
  
- I. Backing Panels:
  - 1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
  
- J. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
  - 1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
  - 2. Fasten with corrosion-resistant screws.
  
- K. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
  - 1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
  - 2. Exterior Trim: Install in the following locations:
    - a. Cornerbead: Use at outside corners.
    - b. LC Bead: Use at exposed panel edges.
  - 3. Interior Trim: Install in the following locations:
    - a. Cornerbead: Use at outside corners, unless otherwise indicated.
    - b. Bullnose Bead: Use at outside corners.
    - c. LC Bead: Use at exposed panel edges.
    - d. L Bead: Use where indicated or necessary.
    - e. U Bead: Use at exposed panel edges.
  
- L. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
  - 1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
  - 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
  - 3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
    - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
    - b. Level 2: Panels that are substrate for tile.
    - c. Level 3: Surfaces be coated with drywall primer prior to final finishes. Heavy or medium texture finishes before final painting, or where heavy-grade wall coverings are to be applied as the final decoration. This level of finish is not recommended where smooth painted surfaces, or light to medium weight wall coverings as specified. Janitorial, Electrical, Technology, & Mechanical Rooms.
    - d. Level 4: For surfaces receiving wall coverings of semigloss and eggshell paints. Hallways, Classrooms & Offices with ceilings 10' or lower
    - e. Level 5: For surfaces receiving semigloss and eggshell paint and surfaces subjected to severe lighting. Band Hall, Libraries, Commons, Flex Spaces & Hallways with Ceilings higher than 10'.

### 3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### **3.5 WORKMANSHIP TOLERANCES**

- A. Visual: Correct any nicks, bumps, out-of-level or out - of-plumb areas detectable to the naked eye.
- B. Walls: 3/8 inch maximum deviation from vertical.
- C. Bumps in Boards: Maximum 1/8 inch in 24 inches.
- D. Corners: Maximum out-of-square 1/8 inch in 16 inches.
- E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.
- F. Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abutts other material or when end is exposed.
  - 1. Manufacturer: 1/4 inch shadow bead as manufactured by Trim-TEX Drywall Solutions.
- G. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.

### **3.6 COMMENCEMENT RESTRICTIONS**

- A. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected.

**END OF SECTION 09 21 16**

## **SECTION 09 30 00 - TILING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Thin set porcelain tile, mortar and grout, sealants, and accessories shown or required to complete work.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data including data sheets, installation recommendation, and recommended joint widths.
- B. Shop Drawings: Show locations of each type of tile and tile pattern.
  - 1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples: Submit samples showing full range of color and texture variations expected.
  - 1. Full size units of each type and composition of tile and for each color and finish required.
  - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
  - 3. Waterproof membrane in 6 x 6-inch sample.
  - 4. Thresholds in 6 inch (150 mm) lengths.
- D. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements for slip resistance.
- E. Maintenance Instructions: Submit maintenance instructions for each type of product specified.
- F. Certifications:
  - 1. Provide Master Grade Certificate as specified in ANSI A137.1.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
  - 2. Surface Burning Characteristics: ASTM E 84; identify products with appropriate markings of applicable testing agency.
    - a. Flame Spread Index: 25 or less.
    - b. Smoke Developed Index: 450 or less.
  - 3. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.

- B. American National Standards Institute (ANSI)
  - 1. Installation Specifications:
    - a. A108, Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
    - b. A108.10, Installation of Grout in Tilework.
  - 2. Material Specifications:
    - a. A118.4, Modified Dry Set Cement Mortar.
    - b. A118.6, Ceramic Tile Grouts.
    - c. A137.1, Ceramic Tile.
- C. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- E. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
  - 1. Stone thresholds.
  - 2. Waterproofing.
  - 3. Joint sealants.
  - 4. Cementitious backer units.
  - 5. Metal edge strips.
- F. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) in new construction or ASTM F1869 (*Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride*) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.
- G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of each type of floor tile installation.
  - 2. Build mockup of each type of wall tile installation.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.



- C. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

## **1.7 EXTRA MATERIALS**

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full size units equal to three (3) percent of amount installed for each type, composition, color, pattern, and size indicated.
  - 2. Grout: Furnish quantity of grout equal to three (3) percent of amount installed for each type, composition, and color indicated.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 – Project Management and Coordination.

## **1.9 WARRANTY**

- A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
  - 1. Damaged tile, including broken or chipped edges.
  - 2. Loose or missing tile.
  - 3. Noticeable deterioration or discoloring of tile or grout.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Specifications are based on products of manufacturers specified. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.
  - 1. Porcelain and Ceramic Tile:
    - a. American Marazzi Tile, Inc.; (972) 226-0110.
    - b. Crossville Ceramics Co.; (931) 484-2110.

- c. Dal-Tile Corp., Dallas, TX; (713) 481-5893.
2. Tile Setting and Grout Materials: Those manufactured by any one (1) of the following. No substitutions.
  - a. Custom Building Products; (562) 598-8808.
  - b. Dal-Tile Corp.; (713) 481-5893.
  - c. Laticrete International, Inc., Bethany, CT; (800) 243-4788.
  - d. Mapei Americas; (800) 426-2734.
- B. Specifications are based on porcelain tile as manufactured by Dal-Tile Corp. Other manufacturers listed shall provide colors and finish equivalent to those specified.

## 2.2 MATERIALS

- A. Tile Type 1 (T1, T2, T3, T5): Porcelain Tile.
  1. Basis of Design: Synchronic as manufactured by Dal-Tile.
  2. Size: 12 inches by 24 inches.
  3. Color: As indicated on Drawings.
  4. Finish: Matte.
  5. Locations: Refer to Drawings.
  6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
  7. Outside corners: To have aluminum Schluter Quadec finishing edge.
  8. Borders and Patterns: As selected by Architect.
- B. Tile Type 2 (T4, T6): Porcelain Tile.
  1. Basis of Design: Synchronic as manufactured by Dal-Tile.
  2. Size: 24 inches by 24 inches.
  3. Color: As indicated on Drawings.
  4. Finish: Matte.
  5. Locations: Refer to Drawings.
  6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
  7. Outside corners: To have aluminum Schluter Quadec finishing edge.
  8. Borders and Patterns: As selected by Architect.
- C. Tile Type 3 (T7, T8) Ceramic Tile.
  1. Basis of Design: Color Match as manufactured by Dal-Tile.
  2. Size: 8 inches by 24 inches.
  3. Color: As indicated on Drawings.
  4. Finish: Matte.
  5. Locations: Refer to Drawings.
  6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
  7. Outside corners: To have aluminum Schluter Quadec finishing edge.
  8. Borders and Patterns: As selected by Architect.
- D. Tile Type 4 (T9): Ceramic Tile.
  1. Basis of Design: Color Wheel Linear as manufactured by Dal-Tile.
  2. Size: 8 inches by 24 inches.
  3. Color: As indicated on Drawings.
  4. Finish: Matte.
  5. Locations: Refer to Drawings.
  6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.

7. Outside corners: To have aluminum Schluter Quadec finishing edge.
  8. Borders and Patterns: As selected by Architect.
- E. Tile Type 5 (T10): Porcelain Tile.
1. Basis of Design: Keystone as manufactured by Dal-Tile.
  2. Size: 2 inches by 2 inches.
  3. Color: As indicated on Drawings.
  4. Finish: Matte.
  5. Locations: Refer to Drawings.
  6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
  7. Outside corners: To have aluminum Schluter Quadec finishing edge.
  8. Borders and Patterns: As selected by Architect.
- F. Tile Type 6 (T11, T12): Porcelain Tile.
1. Basis of Design: Synchronic as manufactured by Dal-Tile.
  2. Size: 4 inches by 24 inches.
  3. Color: As indicated on Drawings.
  4. Finish: Matte.
  5. Locations: Refer to Drawings.
  6. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
  7. Outside corners: To have aluminum Schluter Quadec finishing edge.
  8. Borders and Patterns: As selected by Architect.
- G. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808, or 1300 Universal Bonding Mortar as manufactured Dal-Tile Corp., Dallas, TX; (800)-933-8453, Keraflex Super as manufactured by Mapei Americas, Deerfield Beach, FL; (800)-426-2734.
- H. Grout: LATICRETE® Tri-Poly Fortified Grout as manufactured by Laticrete International, Inc., or Architect approved equal by any one (1) of the approved manufacturers listed above. No substitutions. Color shall be as selected by Architect from manufacturer's standard colors.
- I. Epoxy Grout (At wet areas and restroom floors): Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
1. ARDEX L.P., WA Epoxy Grout; (724) 203-5000.
  2. Polyblend® Tile Grout with 100 percent Solids Epoxy manufactured by Custom Building Products; (562) 598-8808.
  3. LATICRETE® SpectraLOCK PRO Stainless Grout manufactured by Laticrete International, Inc.; (800) 243-4788.
  4. Kerapoxy IEG, 100% Solids, Industrial-Grade Epoxy Grout manufactured by Mapei Americas; (800)-426-2734.
- J. Crack Isolation Membrane:
1. Sheet membrane used to eliminate transmission of substrate cracks from one (1) of the following approved Products/Manufacturers:
    - a. Dalseal CIS manufactured by Dal-Tile.
    - b. Crackbuster manufactured by Custom Building Products.
    - c. Mapelastick SM manufactured by Mapei.
    - d. Nobleseal CIS manufactured by The Noble Company.
    - e. Tileguard manufactured by Polyguard Products, Inc.

2. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
  - a. Blue 92 manufactured by Laticrete International, Inc.
  - b. Fracturefree manufactured by Custom Building Products.
  
- K. Expansion Joint:
  1. Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
  2. Typical Conditions except as specified below: Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.
  3. Conditions exposed to chemicals, food processing, etc.: Polysulfide sealant over filler. ASTM C920, Grade P, Class 25, Uses T and M. Polyspec Thiokol, or Architect approved equal. Self-leveling and flexible sealant over filler of type instructed by manufacturer to suit application. Sealant shall match grout color. Expansion joints shall conform to TCA EJ171.
  
- L. Latex Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by ARDEX ENGINEERED CEMENTS; (724) 203-5000 or comparable product approved by Architect.
  
- M. Edge Protection and Transition Strips:
  1. Basis of Design: Schluter® Systems LP, Plattsburg, NY; (800) 472-4588.
  2. Porcelain Tile to Gyp. Bd.: Schluter® - QUADDEC transition strips in aluminum finish at all porcelain tile wainscot to gyp board transition locations.
  3. Porcelain Tile to Porcelain Tile: Schluter® - QUADDEC transition strips in aluminum finish at all porcelain tile wall outside corner locations.
  4. Porcelain Tile to Carpet: Schluter® - SCHIENE transition strips in aluminum finish at porcelain tile to carpet transition locations.
  5. Porcelain Tile to Sealed Concrete: Schluter® - RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
  6. Stair nosing: Schluter® - TREP-S GS, 10 S, aluminum support with thermoplastic rubber insert.
  7. Edge Protection: Schluter® - DECO-DE. Brushed Stainless.
  8. Provide all corners and connectors as required for a complete and detailed finished installation.
  9. Aluminum trim to be provided where wall tile meets epoxy base.

### **2.3 EXTRA TILE**

- A. Deliver four (4) unopened boxes of tile of each color tile and base from the same tile production run to the Owner at Substantial Completion.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. By General Contractor:
  1. Protect surrounding work from damage or disfiguration.
  2. Vacuum clean and damp clean existing substrate surfaces.
  
- B. By Tile Contractor:
  1. Examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work.

2. Examine substrates defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
  - a. Free of cracks, dry, clean, free of oily or waxy films, free of curing compounds.
  - b. Well cured, firm and level within TCA specified tolerances.
  - c. Minimum of 40 degrees F and rising.
- C. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

### **3.2 INSTALLATION**

- A. Crack Isolation Membrane:
  1. Install crack isolation membrane under tile over building control joints and substrate cracks up to 1/8 inch. Apply a 30 inch wide strip centered on control joint or crack. Install in accordance with TCA F125 and manufacturer's instructions.
  2. Install joint sealant in joint of first tile on both sides of control joint and crack.
  3. Install membrane with products or methods approved by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.
- B. Install porcelain wall tile and porcelain pavers with aligned joints (no staggering), 1/8 inch to 3/16 inch joint width.
- C. Install porcelain pavers over crack isolation membrane in locations shown on drawings in accordance with TCA F125 and ANSI A108.5 recommendations and manufacturer's instructions.
- D. Do not use damaged porcelain tile, including those with broken or cracked edges.
- E. Lay out all work so that, where possible, no tiles less than half size occur.
- F. Install expansion joints in accordance with TCA publication EJ171. Install porcelain tile joints aligned with floor joints.
- G. Install grout in accordance with ANSI A108.10 and manufacturer's instructions.
- H. Install edge protection and transition strips in accordance with manufacturer's instructions.
- I. Damp cure grout in accordance with manufacturer's recommendations. Clean all porcelain tile surfaces upon completion. Protect finish porcelain tile work from damage.

### **3.3 CLEANING AND PROTECTION**

- A. Clean work at completion of installation, remove excess grout from porcelain tile surfaces. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
- B. Remove grout from adjacent finish surfaces.
- C. Protect finished installation until final acceptance.
- D. Do not permit traffic over finished floor surface.

### **3.4 REPAIR**

- A. Repair or replace damaged porcelain tile, including those with broken or cracked edges at no expense to Owner.

**END OF SECTION 09 30 19**

## **SECTION 09 51 00 - ACOUSTICAL CEILING PANELS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Acoustical panels.
  - 2. Concealed and exposed suspension systems for ceilings.
  - 3. Seamless acoustical ceiling system.
  - 4. Accessories necessary for a complete installation.

#### **1.3 RELATED SECTIONS**

- A. Section 09 21 16 – Gypsum Board Assemblies.
- B. Division 23 – Mechanical: Air diffusers and mechanical items penetrating ceiling.
- C. Division 26 – Electrical: Lighting and electrical items penetrating ceiling.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each product including installation instructions.
- B. Samples:
  - 1. Acoustic Panel: Set of 6 inch (150 mm) square samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch (300 mm) long samples of each type, finish, and color.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Size and location of initial access modules for acoustical panels.
  - 4. Items penetrating finished ceiling including but not limited to the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
  - 5. Perimeter moldings.
- D. Maintenance Data: Manufacturer data for finishes for inclusion in maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:

1. Building Code: Comply with applicable requirements of the IBC for interior finishes.
  2. Acoustical Panel Standard: ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance.
    - a. Mounting Method for Measuring NRC: Plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
  3. Surface Burning Characteristics: Ceiling panels with surface burning characteristics complying with IBC Chapter 8 and ASTM E 1264 for Class A materials determined by testing identical products in accordance with ASTM E 84:
    - a. Flame Spread Index : 25 or less
    - b. Smoke Developed Index: 450 or less.
  4. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Source Limitations:
1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
  2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Comply with applicable regulations regarding toxic and hazardous materials.
1. Coating Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.
  2. Panel Based Antimicrobial Treatment: Provide acoustical panels manufactured with antimicrobial treatment in the panels.
- D. Preinstallation Conference: Conduct conference at site.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to site in original, unopened packages and store in a fully enclosed, conditioned space protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, allow panels to attain room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

## 1.8 WARRANTY

- A. Standard Ceiling Panels: Warrant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.

- B. Sag Resistant Ceiling Panels: warrant products to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of ten (10) years from the date of Substantial Completion.
- C. Standard Suspension System: Suspension systems shall be warranted to be free from defects in material or factory workmanship and shall not incur 50 percent red rust as defined by ASTM B117 test procedures for a period of ten (10) years from the date of Substantial Completion.
- D. Suspension system / ceiling panels: Provide manufacturers standard 15 year warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust as defined by ASTM b117 test during the period of the warranty, extra materials.

## 1.9 EXTRA STOCK

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Panels: Full size panels equal to 1 percent of quality installed or 2 full unopened containers, whichever is greater.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturer: Subject to compliance with requirements, provide ceiling panels and grid systems by one of the following:
  - 1. Concealed and Exposed Suspension Grid:
    - a. Armstrong World Industries, Inc.
    - b. CertainTeed Corporation.
    - c. Chicago Metallic; Rockfon North America.
    - d. Hunter Douglas.
    - e. USG Corporation.
  - 2. Acoustical Ceiling Panel:
    - a. Armstrong World Industries, Inc.
    - b. CertainTeed Corporation.
    - c. Tectum Inc.
    - d. USG Corporation.
  - 3. Molding and Edge Trim:
    - a. Armstrong World Industries, Inc.
    - b. CertainTeed Corp.
    - c. Chicago Metallic Corporation.
    - d. Fry Reglet Corporation.
    - e. Gordon, Inc.
    - f. USG Corporation.
  - 4. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.
  - 5. Acoustical Sealant for Concealed Joints:
    - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
    - b. Pecora Corporation; AIS-919.



- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

## 2.2 METAL SUSPENSION SYSTEM

- A. Metal Suspension System: Direct hung metal suspension systems of types, structural classifications, and finishes indicated complying with applicable requirements in ASTM C 635/C 635M.
1. High Humidity Finish: Comply with ASTM C 635/C 635M requirements for *Coating Classification for Severe Environment Performance* where high humidity finishes are indicated.
  2. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1 *Direct Hung*, unless otherwise indicated. Comply with seismic design requirements.
    - a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
      - 1) Type: Cast in place, postinstalled expansion or postinstalled bonded anchors.
      - 2) Corrosion Protection: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
      - 3) Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
      - 4) Corrosion Protection: Components fabricated from nickel copper alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
    - b. Power Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
  3. Wire Hangers, Braces, and Ties:
    - a. Zinc Coated, Carbon Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
    - b. Stainless Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
    - c. Nickel Copper Alloy Wire: ASTM B 164, nickel copper alloy UNS No. N04400.
    - d. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1 *Direct Hung*) will be less than yield stress of wire, but provide not less than 0.106 inch (2.69 mm) diameter wire.
  4. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust inhibitive paint.
  5. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04 inch (1 mm) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16 inch (8 mm) diameter bolts.
  6. Hold Down Clips: Provide hold down clips spaced 24 inches (610 mm) o.c. on all cross tees in areas with exterior opening larger than 48" x 96".

7. Impact Clips: Provide impact clip system designed to absorb impact forces against acoustical panels in Gymnasiums.
8. Aluminum cap for use over steel grid in kitchen areas or where shown on drawings or required.

B. Metal Suspension Systems:

1. Narrow Face, Steel Capped, Double Web, Steel Suspension System: Main and cross runners roll formed from cold rolled steel sheet; prepainted, electrolytically zinc coated, or hot dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished, cold rolled, 9/16 inch (15 mm) wide metal caps on flanges.
  - a. Structural Classification: Intermediate-duty system.
  - b. Face Design: Flat, flush.
  - c. Cap Finish: Color selected by Architect.

### 2.3 ACOUSTICAL PANELS

A. Acoustic Panel Type **ACP-1**:

1. Basis of Design Product: School Zone Fine Fissured by Armstrong World Industries
2. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern:
  - a. Type and Form: Mineral fiber.
  - b. Pattern: E (lightly textured).
  - c. Color: As indicated on Drawings.
3. LR: 82%.
4. NRC: Not less than 0.70.
5. Edge/Joint Detail: Square Lay-in 15/16 inch.
6. Thickness: 3/4 inch
7. Modular Size: 24 by 24 inches (610 by 610 mm).
8. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.
9. Typical Location: Corridors, Storage Areas, MEPT Rooms, Athletics Spaces, Custodial.

B. Acoustic Panel Type **ACP-2**:

1. Basis of Design Product: Cortega 700 as manufactured by Armstrong World Industries.
2. Classification: Provide Fire Retardant panels complying with ASTM E 1264 for type, form, and pattern:
  - a. Type and Form: Mineral fiber.
  - b. Pattern: E (lightly textured).
  - c. Color: As indicated on Drawings.
3. Fire Class: A.
4. LR: 0.80.
5. NRC: 0.55.
6. Edge/Joint Detail: Square Lay-In 15/16.
7. Thickness: 5/8 inch.
8. Modular Size: 24 by 24 inches (610 by 610 mm).
9. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.
10. Typical Location: Classrooms including any teachable space, Science Labs, Offices, Fine Arts Rooms, Arts, CTE Spaces, any area not specifically listed shall be assumed ACP-2

C. Acoustic Panel Type **ACP -3**:

1. Basis of Design Product: Clean Room VL No. 868 by Armstrong World Industries.

2. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern:
    - a. Type and Form: Type IV, mineral base with membrane faced overlay; washable vinyl film overlay.
    - b. Pattern: GH (smooth and printed).
    - c. Color: As indicated on Drawings.
  3. LR: Not less than 0.80.
  4. CAC: Not less than 40.
  5. Edge/Joint Detail: Square.
  6. Thickness: 5/8 inch (15 mm).
  7. Modular Size: 24 by 24 inches (610 by 610 mm).
  8. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.
  9. Typical Location: Kitchen Culinary Practicum and all associated back of house spaces, serving, and FCS Classroom.
- D. Acoustic Panel Type **ACP 4**:
1. Basis of Design Product: Ultima by Armstrong World Industries.
  2. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern:
    - a. Type and Form: Type IV, mineral base with membrane faced overlay; form 2.
    - b. Pattern: E
    - c. Color: As indicated on Drawings.
  3. LR: Not less than 0.80.
  4. CAC: Not less than 40.
  5. NRC: Not less than .70.
  6. Edge/Joint Detail: Square.
  7. Thickness: 5/16 inch
  8. Modular Size: 24 by 24 inches (610 by 610 mm).
  9. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.
  10. Typical Location: Library and Library Support Spaces.

## 2.4 MOLDING, TRIM AND ACCESSORIES

- A. Shadow Molding: Where an acoustical lay in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding similar to Armstrong Shadow Molding No. 7873.
- B. Light Fixture Protection:
  1. Manufacturer: Thermafiber Light Protection Kit by Owens Corning or Type 5/8 or 3/4 P(S) by Armstrong World Industries.
  2. Fire Resistance Rating: Same as ceiling assembly rating.
  3. Locations: At fixtures reinstalled in fire rated ceiling assemblies.
- C. Roll Formed, Sheet Metal Edge Moldings and Trim: Type and profile for standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color used for exposed flanges of suspension system runners.
  1. Provide edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.

2. For lay in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- D. Extruded Aluminum Edge Moldings and Trim: Where indicated, provide extruded aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
  2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
  3. Baked Enamel or Powder Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- E. Acoustical Sealant: Comply with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
  2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant.
- F. Acoustical wall panels in locations that are reachable from ground level to have a "retaining clip" on top of the panel to prevent the panels from being lifted off Z bar.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut for compliance with requirements specified that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation after correcting unsatisfactory conditions.

#### **3.2 PREPARATION**

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less than half width panels at borders, and comply with layout shown on reflected ceiling plans.

#### **3.3 INSTALLATION**

- A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA *Ceiling Systems Handbook*.

1. Fire Rated Assembly: Install fire-rated ceiling systems according to tested fire rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers where required and, if permitted with fire resistance rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast in place hanger inserts, postinstalled mechanical or adhesive anchors, or power actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast in place or postinstalled anchors.
- D. Panel Accessibility: Install panels downward accessible by disengaging hinge support rail on one side of panel from the T Bar Flange or optional A Mount rail flange without the use of tools, for access without removal of panel from the ceiling.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
  - 1. Arrange directionally patterned acoustical panels with pattern running in one direction parallel to long axis of space.
  - 2. For square edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
  - 3. For reveal edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 4. For reveal edged panels on suspension system members with box shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
  - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  - 6. Install hold-down clips in areas indicated, in areas with exterior opening larger than 48" x 96", where required by authorities having jurisdiction; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
  - 7. Install clean room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Compliance of seismic design.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
  - 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
    - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.5 CLEANING**

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**END OF SECTION 09 51 00**

## **SECTION 09 64 66 – REFINISHING WOOD ATHLETIC FLOORING**

### **PART 1 - GENERAL**

#### **1.1 RELEATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Moving of existing bleachers.
- B. Removal of existing wall base, door thresholds, and volleyball floor inserts/plates.
- C. Sanding and refinishing flooring.
- D. Installation of new game lines and logos.
- E. Refastening of existing bleachers, wall base, door thresholds, and volleyball floor inserts/plates in order to complete work as shown on drawings or required.

#### **1.3 REFERENCES**

- A. Maple Flooring Manufacturers Association, Inc. (MFMA).

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's technical data, specifications and instructions for each type of wood flooring finish.
  - 2. Manufacturer's storage, installation, and finishing instructions.
  - 3. Manufacturer's maintenance instructions.
- B. Shop Drawings: Contractor shall document exact floor markings and logos prior to starting work and submit to Architect for record, the drawings of each gym floor indicating exact location and types of markings and logos, which are to be repainted to similar layout and extents as the existing court and game lines. Confirm new layout and logos with Owner and Architect prior to submittals.
- C. Samples:
  - 1. Flooring Finish:
    - a. Actual samples, of adequate size, of flooring finish and game line paint colors for Architect's approval.
    - b. Approved colors and finish sample will be basis for which work will be judged.
- D. Evidence of Contractor's qualifications.

#### **1.5 QUALITY ASSURANCE**

- A. Contractor Qualifications: Company specializing in refinishing flooring systems of the type used on these Projects, with a minimum of five (5) years' experience.
- B. Contractor shall document exact floor markings and logos prior to starting work and submit to Architect for record, the drawings of each gym floor indicating exact location and types of



markings and logos, which are to be repainted to similar layout and extents as the existing court and game lines. Confirm new layout and logos with Owner and Architect prior to submittals.

#### **1.6 INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 – Project Management and Coordination.

#### **1.7 PROJECT CONDITIONS**

- A. Permanent heat, light and air conditioning shall be operating a week prior to, during and after refinishing operations, maintaining a temperature range of 65 degrees F to 75 degrees F. Humidity conditions within the building shall approximate humidity conditions which will prevail when building is occupied, but shall not be allowed to fall below 35 percent or be higher than 50 percent.
- B. Do not start Work of this Section until all wet and overhead work, if any, i.e., painting, plaster, etc., is completed.

#### **1.8 COORDINATION**

- A. Contractor performing work of refinishing flooring shall coordinate his work with that of contractor performing work of other sections, especially wet and overhead work, if any, i.e., painting, plaster, etc., and do not start Work of this Section until such work is completed.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Specifications are based on specified products manufactured by Hillyard, Inc., St Joseph, MO; (800) 365-1555. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

#### **2.2 MATERIALS**

- A. Finishing Materials:
  - 1. Sealer: Water-based wood gym seal similar to Court Guard™.
  - 2. Finish: Water-based Oil modified urethane similar to Contender® Finish. Finish and color will be selected by Architect from finish manufacturer's available colors.
- B. Tacking Solution: Water-based tacking solution similar to Court Prep®.
- C. Game Lines and Logo Paint: Water-based gym line marking paints similar to Contender® Line Paints or those recommended by the finishing materials manufacturer to be compatible with finish. Colors shall match existing layout, unless shown otherwise on drawings.
- D. Other Materials: Provide other materials, not specifically described but required for a complete and proper refinishing installation.
- E. Materials or products, i.e., existing bleachers, wall base, door thresholds, and volleyball floor inserts/plates, which are damaged during removal or which cannot be properly reinstalled shall be replaced with new undamaged materials or products to match existing undamaged materials or products at no expense to Owner.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine existing work to ensure that it is ready to start Work of this Section.
- B. Ensure wet and overhead work, if any, has been completed.
- C. Field measure and provide as-built drawing for existing linework, floor inserts, and artwork including dimensions and colors.

#### **3.2 PREPARATION**

- A. Unfasten bleachers from wall and move onto floor system when refinished in major floor area.
- B. Remove existing wall base, door thresholds, and volleyball floor inserts/plates, as shown or required.
- C. Protect and cover bleachers before starting the process of sanding flooring.

#### **3.3 SANDING**

- A. Sand according to MFMA accepted methods making your final cut with 80-100 grit paper. Screen with 120 grit disc and vacuum thoroughly.
- B. After sanding, tack the floor in accordance with manufacturer's recommendations. Tack until there is no visible dust on tacking towels.
- C. Vacuum or tack floor before first coat of finish.
- D. Floor shall present a smooth surface without drum stop marks, gouges, streaks or shiners.

#### **3.4 FINISHING**

- A. Apply one (1) coat of sealer and one (1) coat of finish in accordance with manufacturer's instructions.
- B. Apply game lines and logos accurately in accordance with existing layout. Lines shall be straight with sharp edges in colors to match existing, unless shown or directed otherwise.
- C. Apply two (2) coats of finish in accordance with manufacturer's instructions.

#### **3.5 REINSTALLATION OF REMOVED ITEMS AND BLEACHER REFASTENING**

- A. Reinstall existing wall base, thresholds, and volleyball floor inserts/plates removed in order to refinish existing flooring.
- B. Move bleachers back against the wall, after completion and finishing flooring in closed position, refastening to wall.

#### **3.6 CLEANING AND PROTECTION**

- A. Upon completion of floor refinishing, clean up all unused materials and debris and remove from the premises.

- B. Leave flooring, bleachers and gymnasium clean and ready to use.
- C. Keep the floor closed to all traffic for 72 hours, and do not schedule activities for one (1) week.

**END OF SECTION 09 64 66**

## **SECTION 09 65 00 - RESILIENT FLOORING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

#### **1.3 REFERENCES**

- A. ASTM International:
  - 1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
  - 2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
  - 3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
  - 4. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
  - 5. ASTM F 1861 Standard Specification for Resilient Wall Base
  - 6. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
  - 7. ASTM F 1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing
  - 8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- B. National Fire Protection Association (NFPA):
  - 1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
  - 2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials.

#### **1.4 SYSTEM DESCRIPTION**

- A. Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.
- B. Administrative Requirements
  - 1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
  - 2. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e. moisture tests, bond test, pH test, etc).
- C. Test Installations/ Mock-ups: Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate

testing. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.

1. Mock-Up Size: Coordinate with Architect and Owner.
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into the final construction with Owner's approval.

D. Sequencing and Scheduling

1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

## 1.5 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories.
- C. Submit Safety Data Sheets (SDS) available for adhesives, weld rod, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
- D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- E. Closeout Submittals: Submit the following:
  1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
  2. Warranty: Warranty documents specified herein.

## 1.6 QUALITY ASSURANCE

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
- B. Select an installer who is experienced and competent in the installation of resilient sheet flooring.
  1. Engage installers certified as Commercial Flooring Certified Installers
  2. Confirm installer's certification by requesting their credentials
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

- D. Fire Performance Characteristics: Provide resilient vinyl sheet flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
  2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
  3. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- C. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

## **1.8 PROJECT CONDITIONS**

- A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of 85°F (29°C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.

## **1.9 WARRANTY**

- A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- B. Limited Warranty Period: 20 years.
- C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

## **1.10 EXTRA STOCK**

- A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
1. Flooring: 1 percent of quality installed or 2 full unopened containers, whichever is greater.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER**

- A. Basis of Design Product: Manufacturers and tile series, pattern, and color selections are indicated in the Finish Schedule and are a basis of design. Subject to compliance with

requirements, provide product indicated in Finish Schedule or comparable product approved by Architect.

## **2.2 RESILIENT FLOORING MATERIALS**

- A.** Luxury Vinyl Tile (RFT1):
  - 1. Basis of Design: Palladian as manufactured by Tarkett.
  - 2. Type: Printed Film with Translucent Wear Layer.
  - 3. Size: 12 inches by 36 inches.
  - 4. Color: Refer to Drawings.
  - 5. Location: Refer to Drawings.
  
- B.** Luxury Vinyl Tile (RFT2 and RFT3):
  - 1. Basis of Design: Mineral Basalt as manufactured by Tarkett.
  - 2. Type: Printed Film with Translucent Wear Layer.
  - 3. Size: 12 inches by 36 inches.
  - 4. Color: Refer to Drawings.
  - 5. Location: Refer to Drawings.

## **2.4 WALL BASE MATERIALS**

- A.** For integral flash cove base: Provide integral flash cove wall base by extending sheet flooring 4 in. (10.16 cm) up the wall using adhesive, welding rod, and accessories recommended and approved by the flooring manufacturer.

## **2.5 ADHESIVES**

- A.** Provide Vinyl Sheet Flooring Adhesive Premium Commercial adhesive for field areas or flooring manufacturer's comparable product to be approved by the Architect.

## **2.6 ACCESSORIES**

- A.** For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide manufacturer's Cement-Based Patch and Underlayment or flooring manufacturer's comparable product to be approved by Architect.
- B.** For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- C.** Provide transition/reducing strips tapered to meet abutting materials.
- D.** Provide threshold of thickness and width as shown on the drawings.
- E.** Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- F.** Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

## **PART 3 - EXECUTION**

### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

### 3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e. moisture tests, bond test, pH test, etc.).
- B. Visually inspect flooring materials, adhesives and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

### 3.3 PREPARATION

- A. Refer to section 03 54 16 – Hydraulic Cement Underlayment for floor preparation and pre-testing.
- B. Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with flooring manufacturer as recommended by the flooring manufacturer. Refer to ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.
- C. Subfloor Preparation Moisture Mitigation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, mitigate moisture and other defects with acrylic primer for porous substrates as recommended by the flooring manufacturer. Refer to ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.
- D. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the



substrate they must be mechanically removed prior to the installation of the flooring material. Refer to ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.

- E. When using S-599 Adhesive, perform subfloor moisture testing in accordance with ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes and Bond Tests to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Internal relative humidity of the concrete shall not exceed 90%. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained]
- F. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

### 3.4 INSTALLATION OF FLOORING

- A. Install flooring in strict accordance with the latest edition of manufacturer's manual. Failure to comply may result in voiding the manufacturer's warranty listed in Section 1.08.
- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.
- F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.
- G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

### 3.5 INSTALLATION OF ACCESSORIES

- A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

- D. Apply butt-type metal edge strips where shown on the drawings, [before] [after] flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

### **3.6 CLEANING**

- A. Perform initial and on-going maintenance according to manufacturer's instructions.

### **3.7 PROTECTION**

- A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

**END OF SECTION 09 65 00**

## **SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Rubber base
  - 2. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data for each type of product including manufacturer's installation instructions.
- B. Samples: Sample of Base Selected or Color Chart if none selected.
- C. Maintenance Data: Submit for inclusion in maintenance manuals.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store base and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

#### **1.6 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
- C. Close spaces to traffic for 48 hours after installation.

## 1.7 WARRANTY

- A. Warrant the work specified herein for five (5) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to:
  - 1. Delamination from substrate.
  - 2. Deterioration or fading.
  - 3. Loose off wall.

## 1.8 ATTIC STOCK

- A. Provide two (2) unopened boxes of the same color and size of rubber base as used in the project. Extra material to be provided in boxes of 4 foot lengths only; no coiled base.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Basis of Design Product: Manufacturers and tile series, pattern, and color selections are indicated in the Finish Schedule and are a basis of design. Subject to compliance with requirements, provide product indicated in Finish Schedule or comparable product by one of the following:
  - 1. Johnsite, a division of Tarkett Group.
  - 2. Mannington Commercial.
  - 3. Roppe.
- B. Rubber Base (RB-1): ASTM F1861.
  - 1. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B.
  - 2. Manufacturing Method: Group I (solid, homogeneous).
  - 3. Style: Topset cove; minimum 100 foot coil, cut to length required.
  - 4. Minimum Thickness: 0.125 inch (3.2 mm).
  - 5. Color: Black Brown.
  - 6. Height: 4 inches, unless indicated otherwise.
  - 7. Outside Corners: Job formed.
  - 8. Inside Corners: Job formed.
- C. Adhesives: Water resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified for other work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Immediately before installation, sweep clean substrates to be covered by resilient base.

### **3.3 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- C. Resilient Base: Comply with manufacturer's written instructions for installing resilient base. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
  - 1. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
  - 2. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
  - 3. Do not stretch resilient base during installation.
  - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
  - 5. Preformed Corners: Install preformed corners before installing straight pieces.
  - 6. Job Formed Corners:
    - a. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
    - b. Form without producing discoloration (whitening) at bends.
    - c. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
      - 1) Miter or cope corners to minimize open joints.

**END OF SECTION 09 65 13**

## **SECTION 09 67 00 – FLUID APPLIED FLOORING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Epoxy floor system.
  - 2. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data: Technical data for each type of product indicated include manufacturer's technical data, application instructions, and recommendations for each flooring component required.
- B. Samples: Submit flooring system required, 6 inches (150 mm) square, applied to a rigid backing.
  - 1. Two samples indicating range of slip resistant textures
  - 2. Two samples of actual color and texture selected by the Architect.
- C. Reports and Certificates:
  - 1. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Maintenance Data: Submit data for flooring system to include in maintenance manuals.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements of the IBC for interior floors.
  - 2. Fire Test Response Characteristics: Determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 3. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
  - 4. Flammability: Self-extinguishing according to ASTM D 635.
- B. Installer Qualifications: Installer having minimum 5 years documented experience in the installation of epoxy floors and who is a manufacturer authorized representative trained and approved for installation of flooring systems required. Engage installer certified in writing by floor manufacturer as qualified to apply flooring systems indicated.
- C. Source Limitations: Obtain primary flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

- D. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.
- E. Preinstallation Conference: Conduct conference at site.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

### **1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during flooring application and for 24 hours after application unless manufacturer recommends a longer period.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Basis of Design: DexoTex Décor Flor Broadcast by Crossville Products; subject to compliance with requirements, provide products by one of the following:
  - 1. BASF Corporation; Construction Systems.
  - 2. Sherwin-Williams Company, General Polymers.
  - 3. Sika Corporation; Flooring.
  - 4. Stonehard Epoxy Floors.
- B. Flooring System: Monolithic, colored quartz broadcast floor surface, consisting of color quartz crystals embedded in a clear epoxy matrix with grout coat and epoxy topcoat producing a seamless floor with integral cove base.
- C. System Physical Properties: Provide epoxy flooring system with the following minimum physical property requirements when tested according to test methods indicated:
  - 1. Compressive Strength: 11,000 psi (738 kg/cm<sup>2</sup>) minimum according to ASTM C 579.
  - 2. Tensile Strength: 1800 psi (127 kg/cm<sup>2</sup>) minimum according to ASTM C 307. (resin and hardener).
  - 3. Flexural Modulus of Elasticity: 4000 psi (907 kg/cm<sup>2</sup>) minimum according to ASTM C 580.
  - 4. Elongation: 19.6 percent according to ASTM D638
  - 5. Water Absorption: > 1.0 percent maximum according to ASTM C 413.
  - 6. Indentation: 0.011 inch (0.28 mm) percent maximum according to MIL-D-3134J.
  - 7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16 inch (1.6 mm) permanent indentation according to MIL-D-3134J.
  - 8. Abrasion Resistance: 0.09 gr (CS 17, 1000 gr load, 1000 cycles) maximum weight loss according to ASTM D 4060.

9. Hardness: 80-85, Shore D according to ASTM D 2240.
  10. Flammability: Self-extinguishing bonded to concrete according to ASTM D635.
  11. Antimicrobial Resistance: Passes Rating 1 according to ASTM G21.
  12. Adhesion: > 400 psi (28.1 kg/cm) according to ASTM D4541.
- D. System Characteristics:
1. Color and Pattern: Selected by Architect from manufacturer's full range.
  2. Wearing Surface: Textured for slip resistance.
  3. Overall System Thickness: 1/8 inch to 1/16 inch.
- E. Antimicrobial Additive: Antimicrobial chemical additive to control growth of most bacteria, fungi, algae and actinomycetes.
- F. Primer/Waterproofing Membrane: Type recommended by flooring manufacturer for substrate and flooring system indicated.
- G. Patching and Fill Material: Resinous product approved by flooring manufacturer and recommended by manufacturer for application indicated.
- H. Grout Coat:
1. Resin: Epoxy.
  2. Formulation Description: 100 percent solids.
  3. Type: Pigmented.
  4. Thickness of Coat: Thickness recommended by flooring manufacturer.
- I. Topcoats: Sealing or finish coats.
1. Resin: Epoxy.
  2. Type: Clear.
  3. Number of Coats: Two.
  4. Thickness of Coats: 8 mils (0.2 mm) or as recommended by flooring manufacturer
  5. Finish: Matte.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Remove existing floor covering, adhesives, and contaminates. Ensure existing concrete floor is ready to receive epoxy floor covering.
  2. Roughen concrete substrates complying with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
  3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  4. Verify that concrete substrates are dry and moisture vapor emissions are within acceptable levels according to manufacturer's written instructions. Test results must be submitted to Owner and Architect for approval prior to installation.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.



- b. Plastic Sheet Test: ASTM D 4263. Proceed with application after testing indicates absence of moisture in substrates.
  - c. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
5. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Epoxy Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

### 3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer/Waterproofing Membrane: Apply primer or waterproofing membrane over entire substrate surface in manufacturer's recommended thickness.
1. Apply to integral cove base substrates.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: 4 inches (100 mm) high.
- D. Adhesion (Grout) Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface.
- E. Quartz Granules: Trowel or squeegee quartz granules into wet adhesion coat. Scrape off and vacuum up excess aggregate.
- F. Topcoats: Trowel or squeegee apply clear epoxy resin coat topcoats indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

### 3.3 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

**END OF SECTION 09 67 00**

FLUID APPLIED FLOORING  
09 67 00 - 5

## **SECTION 09 68 00 - CARPETING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Carpet and pad.
  2. Carpet Mat.
  3. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data including installation recommendations for each type of substrate:
  1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Samples: For each products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  1. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
  2. Exposed Edge, Transition, and Other Accessory Stripping: 12 inch (300 mm) long Samples.
  3. Carpet Seam: 6 inch (150 mm) Sample.
  4. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
  5. Carpet base and accessory samples.
- C. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.
- D. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.
- E. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
  1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
  - 2. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E 648. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
  - 3. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS).
- B. Installer Qualifications: Installer having minimum 5 years documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- D. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab level on a flat surface, stacked no higher than two rolls.
- C. Store materials in area of installation for minimum period of 48 hours prior to installation.
- D. Protect carpet from damage, dirt, stains, and moisture.

## 1.7 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

## 1.8 COORDINATION

- A. Contractor's responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

## 1.9 WARRANTY

- A. Carpet: Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
  - 1. Provide a lifetime warranty from substantial completion date manufacturer's written warranty for materials and labor.
  - 2. Contractor to provide written one (1) year warranty for labor and materials from substantial completion date.
  - 3. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.

## 1.10 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Basis of Design Manufacturer: Tarkett. Other Manufacturers must be approved prior to Bid.
- B. Carpet (CP-1):
  - 1. Basis of Design: Products as manufactured by Tarkett.
  - 2. Line: Aftermath II.
  - 3. Construction: Stratatec Patterned Loop.
  - 4. Yarn: Dynex SD Nylon.
  - 5. Dye Method: 100% Solution Dyed.
  - 6. Pile Thickness: 0.080" (2.06 mm).
  - 7. Color: As indicated on Drawings.
  - 8. Basis of Design Backing : Powerbond Cushion RS Backing System by Tarkett.
    - a. Size: 6 foot roll.
- C. Carpet (Walk-Off) (CP-2):
  - 1. Basis of Design Product/Manufacturer: "Assertive Action" as manufactured by Tandus (Collins and Aikman) Commercial Floor Systems, Dalton GA; (404) 259-9711.
  - 2. Type: Patterned carpet tiles.
  - 3. Construction: Accuweave® Patterned Loop
  - 4. Color(s): As indicated on Drawings.
  - 5. Locations: As shown on drawings.
  - 6. Basis of Design Backing : Powerbond Cushion RS Backing System by Tarkett.
    - a. Size: 6 foot roll.
- D. Carpet Mat:
  - 1. Basis of Design: DesignStep as manufactured by Construction Specialties, Inc.
  - 2. Description: Polypropylene fiber carpet with nitrile backing and frame.
  - 3. Carpet:
    - a. Material: 100% UV Resistant polypropylene.
    - b. Face Weight: 44oz.
    - c. Thickness: 1/2 inch.
    - d. Size: 3 inches by 5 inches.

- e. Color: As selected by Architect from Manufacturer's full range.
- E. Applied Soil Resistance Treatment: Standard with manufacturer.
- F. Antimicrobial Treatment: Standard with manufacturer.
- G. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.
- H. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.
- I. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.
- J. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- K. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- L. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional three (3) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps. Attic stock to be delivered to District Warehouse.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet and cushion manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Section 03 30 00 for slabs receiving carpet.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation after correcting unsatisfactory conditions.

#### **3.2 PREPARATION**

- A. Comply with CRI 104, Section 7.3 *Site Conditions; Floor Preparation* and with carpet manufacturer's written installation instructions for preparing substrates.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### **3.3 INSTALLATION**

- A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
  - 1. Direct Glue Down Installation: Comply with CRI 104, Section 9 *Direct Glue Down Installation*.
  - 2. Stair Installation: Comply with CRI 104, Section 13 *Carpet on Stairs* for glue down installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
  - 1. Do not bridge building expansion joints with carpet.
  - 2. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
  - 3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, *Patterned Carpet Installations* and with carpet manufacturer's written recommendations.

### **3.4 CLEANING AND PROTECTING**

- A. Perform cleaning operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, *Protecting Indoor Installations*.
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer.

**END OF SECTION 09 68 00**

## **SECTION 09 81 00 - ACOUSTIC INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Acoustical insulation (Sound Attenuation).
  - 2. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### **1.4 RELATED SECTIONS**

- A. Section 04 20 00 - Unit Masonry.
- B. Section 09 21 16 - Gypsum Board Assemblies.
- C. Section 09 51 00 - Acoustical Ceiling Panels.
- D. Division 23 – Mechanical: Duct Insulation.

#### **1.5 SUBMITTALS**

- A. Product Data: Technical data and installation instructions for each type of insulation product specified.
- B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect's approval.
- C. Certifications:
  - 1. Manufacturer's certification of compatibility of rigid insulation with dampproofing mastic.
  - 2. Manufacturers affidavit that materials used in Project contain no asbestos.

#### **1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization.
    - a. Surface Burning Characteristic: ASTM E 84.
      - 1) Flame Spread Index: Maximum 25.
      - 2) Smoke Developed Index: Maximum 450.
    - b. Fire Resistance Ratings: ASTM E 119.
    - c. Combustion Characteristics: ASTM E 136.



2. National Fire Prevention Association (NFPA) 255 Test of Surface Burning Characteristics of Building Materials.
  3. Underwriter's Laboratories (UL) 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.
- C. Environmental Requirements: Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
1. Wherever possible, provide boards from manufacturers who recycle insulation materials.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

### **1.8 PROJECT CONDITIONS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence Work to ensure fireproofing and firestop materials are in place before beginning Work.

## **PART 2 - PRODUCTS**

### **2.1 APPROVED MANUFACTURERS/PRODUCTS**

- A. Specifications are based on any of the manufacturers listed below, with their product in parenthesis for the particular insulation application. Other manufacturers not listed must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.

### **2.2 ACOUSTICAL INSULATION (SOUND ATTENUATION)**

- A. Acoustical Insulation (Sound Attenuation), Unfaced: ASTM C 612, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Guardian Building Products, Inc.
    - c. Johns Manville; a Berkshire Hathaway company.
    - d. Knauf Insulation.
    - e. Owens Corning.
  2. Thickness/R- Values (minimum):
    - a. 3-1/2 inches/ R-11 where shown on the Drawings.
    - b. 6 inches/ R-19 above lay-in ceiling specified and where shown on Drawings.

## **2.3 INSULATION FASTENERS**

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - 1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
  - 2. Spindle: Coppercoated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - 1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
  - 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches (50 mm) between face of insulation and substrate to which anchor is attached.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

## **2.4 ACCESSORIES**

- A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### **3.2 INSTALLATION**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Acoustical Walls: Insulation shall be friction fit between studs and provide full coverage where indicated on Drawings. Insulation shall be tight within spaces and partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.

### **3.3 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 09 81 00**

## **SECTION 09 84 00- ACOUSTIC ROOM COMPONENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### **1.3 SUBMITTALS**

- B. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- C. Shop Drawings: Show panel joints, detail references, dimensions and methods of attachment.
- D. Samples: 12 inch x 12 inch sample of actual material and color charts showing manufacturer's full range of colors for Architect's selection.

#### **1.4 QUALITY ASSURANCE**

- A. Provide acoustical panels, diffusers and fabrics of each type required from one (1) manufacturer, of uniform texture and color.
- B. Installer. Provide evidence of appropriate experience in system installation and that installation method proposed is acceptable to panel manufacturer.
- C. Single Source Responsibility: Obtain acoustical panel materials from a single manufacturer.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Carefully protect work during shipment, storage and installation.
- B. Deliver materials to job site and store elevated above floor in an enclosed space with proper ventilation and protection from damage.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturers listed who produce equivalent products to those specified may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Acoustical Panels:
    - a. AVL Systems, Inc.
    - b. Benton Brothers Solutions, Inc.

- c. Conwed Designscapes
  - d. Decoustics
  - e. Golterman & Sabo, Inc.
  - f. Lamvin, Inc.
  - g. MBI Products Company
  - h. Sound Concepts
  - i. Wall Technology, Inc.
  - j. Guilford of Maine
  - k. TRI-KES
  - l. Carnegie
  - m. Wenger.
2. Wood Fiber Acoustical Panels: Tectum Inc., an Armstrong Ceiling and Wall Company or comparable product.

## 2.2 MATERIALS

- A. Acoustical Absorption Panels:
1. Acoustical Panel type (ARC1-3): Fabric-Faced Panels Above 7'0" AFF.
    - a. Basis of design: Anchorage as manufactured by Guildford of Maine.
    - b. Type: Absorber Panels.
    - c. Size: Refer to Drawings.
    - d. Color: As indicated on Drawings.
    - e. Mount: As recommended by Manufacturer.
    - f. Location: Refer to Drawings.
- B. Tectum Standard Interior Panels (ARC2):
1. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
  2. Thickness: Two (2) inches.
  3. Edge: Long edge beveled.
  4. NRC: 0.70.
  5. Color: As indicated on Drawings.
  6. Size: 2 feet by 4 feet.
  7. Frame: 2 inch by 4 inch painted wood at walls only.
  8. Finish/Color: Factory finish and field painted in color selected by Architect.
  9. Mounting Style: Mount on 3/4 inch furring strips at 24 inch on center both ways on walls, and provide Unitstrut channels and hangers at 24 inches both ways at ceiling attached to steel angles and girders. Type instructed by manufacturer to suit application. Provide all fasteners, and furring strips for a complete single source installation. Fasteners and anchorage accessories shall be corrosive resistant.
  10. Location: Refer to the Drawings.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Verify dimensions to insure proper fabrication of materials.
- B. Verify proper installation location as determined by The Drawings.

### 3.2 INSTALLATION

- A. Install wall panels, ceiling diffusers, and fabrics only after all wet work has been completed and temperature conditions approximate conditions when space will be occupied.

- B. Install wall panels, ceiling diffusers, and fabrics in accordance with manufacturer's instructions and approved shop drawings.
- C. Install Tectum Wall Panels with venting space between the wall and panels in accordance with manufacturer's instructions.
- D. Install wall panels, and ceiling diffusers in proper alignment. Shim wall track as necessary to provide a level frame work.
- E. Arrange wall panels symmetrically on each wall, unless otherwise indicated.
- F. Remove wall panels, ceiling diffusers, and fabrics are damaged and unacceptable to Architect and replace with new undamaged materials at no expense to Owner.

**END OF SECTION 09 84 00**

## **SECTION 09 90 00 - PAINTINGS AND COATINGS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Surface preparation and field painting of exposed items and surfaces.
  2. Field preparation and painting of factory primed metal products and fabrications.
  3. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Standard coating terms defined in ASTM D 16 apply.
  1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
  2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
  3. Semigloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
  4. Full gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
  1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
  2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.
- B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
  1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
  2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
  3. Submit samples on following substrates for review of color and texture only:
    - a. Concrete: Provide two 4 inch square samples for each color and finish.
    - b. Concrete Masonry: Provide two 4" x 8" samples of masonry, with mortar joint in the center, for each finish and color.
    - c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
    - d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

- C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.
- D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with Finish Schedule, Area Detail designating where each product/color/finish was used, product/color/finish was used, product data pages, Manual Safety Data sheets, care and cleaning instructions, touchup procedures, and color samples of each color and finish used.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
  - 2. Performance and Durability:
    - a. ASTM D 16 – "Standard Test Method for Load Testing Refractory Shapes at High Temperatures."
    - b. ASTM D 2486 – "Standard Test Method for Scrub Resistance of Interior Wall Paint."
    - c. ASTM D 2805 – "Standard Test Method for Hiding Power of Paints by Reflectometry."
    - d. ASTM D 4828 – "Standard Test Method for Practical Washability of Organic Coatings."
    - e. ASTM D 3363 – "Standard Test Method for Film Hardness by Pencil Test."
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F (7 degrees C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.7 FIELD CONDITIONS

- A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).
- B. Do not thin or add water to waterbased paints, including waterbased alkyds.
- C. Weather Conditions:
  - 1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
  - 2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
  - 3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

- D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
  - 1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
  - 2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- E. Provide lighting level of 80 foot candles (860lx) measured midheight at substrate surface.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

### 1.8 WARRANTY

- A. Written warranty signed by the manufacturer and the installer in which the manufacturer and installer agree to repair or replace paint and primers that fail within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Flaking or delamination of paint with the substrate.
    - b. Rust, scale, similar imperfections due to improper surface preparation.
    - c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
    - d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
    - e. Deterioration or loss of color of paint beyond normal weathering.
  - 2. Warranty Period: Two (2) years from date of Substantial Completion.

### 1.9 EXTRA MATERIALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: Provide custom color cards for every color used.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Basis of Specifications: Sherwin Williams paints. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
  - 1. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including per cent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.
  - 2. Paint Products:
    - a. PPG Industries, Inc.
    - b. Sherwin-Williams Co.
- B. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.



- C. **Material Quality:** Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.
- D. **Chemical Components of Interior Paints and Coatings:** Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 1. **Aromatic Compounds:** Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  - 2. **Restricted Components:** Paints and coatings shall not contain components restricted by the EPA.
- E. **Accessories:** Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- F. **Patching Materials:** Latex filler compatible with paint systems.
- G. **Fastener Head Cover Materials:** Latex filler.

## 2.2 SOURCE QUALITY CONTROL

- A. **Testing of Paint Materials:** Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
  - 1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
  - 1. **Maximum Moisture Content of Substrates:** When measured with an electronic moisture meter as follows:
    - a. Concrete: 12 percent.
    - b. Fiber Cement Board: 12 percent.
    - c. Masonry (Clay and CMUs): 12 percent.
    - d. Wood: 15 percent.
    - e. Gypsum Board: 12 percent.
    - f. Plaster: 12 percent.
  - 2. Test cementitious and plaster cement/stucco for alkalinity (pH).

- C. Gypsum Board Substrates: Verify joints are taped and finishing compound is sanded smooth.
- D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.
- E. Spray Textured Ceiling Substrates: Verify surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
  - 1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
    - a. Note: If previously painted surfaces have failed to accept new paint systems, determine cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.
- G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

### 3.2 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
  - 1. All ferrous metal
  - 2. All exterior galvanized metal
  - 3. All exterior wood
  - 4. All interior wood
  - 5. All prime coated hardware
  - 6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
  - 7. Aluminum and copper items, unless noted otherwise. (Painting of exposed pipe, including copper, brass, galvanized and black iron pipe and fittings, *is* included.)
  - 8. All metal grilles, except aluminum, unless otherwise indicated.
  - 9. All exposed gypsum board surfaces, including all mechanical rooms.
  - 10. Sealants of types which should not be painted and to which paint will not adhere.
  - 11. Aluminum, stainless steel, nickel and chrome plated piping and fittings.
  - 12. Miscellaneous other items which normally require painting or are scheduled to be painted.
  - 13. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
  - 14. All exposed mechanical equipment and electrical equipment.
  - 15. Traffic lanes and parking spaces including fire lanes and crosswalks.
  - 16. Rolling doors.
  - 17. Bollards.
  - 18. Loose lintels.
  - 19. Wood Fiber Decks.
  - 20. Refer to MEP specifications for additional items to receive paint.
- B. Accessible Parking Space for pavement:
  - 1. "No Parking" painted on any access aisle adjacent to the parking space.
  - 2. Letter height at least 12 inches and a stroke width of at least two inches.
  - 3. Centered within each access aisle adjacent to the parking space.
- C. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats

of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

### 3.3 PREPARATION

- A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
1. Preprimed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or preprimed substrates.
  2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
  3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
  4. Seal marks which may bleed through surface finishes.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting
1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
  2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
  3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
  5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.
- C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
  2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
  3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
  4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

5. Aluminum Substrates: Remove surface oxidation.
- D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.
- E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.
- F. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
  1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
  2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
    - a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
    - b. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m).
    - c. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
    - d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
    - e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.
  3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.
- G. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
  1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
  2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- H. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.

- J. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.
- K. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- L. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar defects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
  - 1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
  - 2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
  - 3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
  - 4. Allow patching and repair compounds to set and cure before painting.
- M. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- N. Wood Substrates:
  - 1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
  - 4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
  - 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- O. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.
- P. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
  - 1. Assure compatibility with product of wall covering manufacturer.
  - 2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
  - 3. Apply release coat in accordance with manufacturer's recommendations.
- Q. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Do not use thinners for water based paints.
  - 4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.4 APPLICATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
1. The term *exposed surfaces* includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
  2. Use applicators and techniques suited for paint and substrate indicated.
  3. Provide finish coats compatible with primers.
  4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
    - a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
    - b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
    - c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
  6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
  11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  12. Provide finish coats compatible with primers used.
  13. Sand lightly between each succeeding enamel or varnish coat.
- B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, operating parts, and labels.
- C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.

- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
  2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
  3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
  3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
  4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
  5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
  6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
  7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.
- G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
  3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
  5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
  6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.
- I. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.
- J. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
  2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- L. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
  2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
  3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
  4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

### 3.5 FIELD QUALITY CONTROL

- A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.



### 3.6 CLEANING AND PROTECTION

- A. It is of the utmost importance to the client that the site remains in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.
- B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide *Wet Paint* signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.
- F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer's recommendations and environmental regulations.

### PART 4 - SCHEDULES

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Exterior Surfaces:
  - 1. Exterior Paint Systems: ASTM 523.
    - 1. Temporary Wood Deck: 2 coat systems, product equal to BEHR Premium Deckover.
    - 2. Temporary Wood Ramp: Top Coat Additive, product equal to BEHR Premium Non-Skid Floor Finish Additive.
- C. Interior Surfaces:
  - 1. Galvanized Metal:
    - a. Primer: DTM Bonding Primer (B66A00050).
    - b. Finish: Pro Industrial Multi-Surface Acrylic Eg-Shel (B66 1560).
  - 2. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
    - a. Shop coat by others.
    - b. DTm Bonding Primer (B66A00050).
    - c. Pro Industrial Multi Surface Acrylic Ed-She; (B66-150 Series).
  - 3. Gypsum Wallboard:
    - a. Primer: One (1) coat PVA Drywall Primer & Sealer (B28-8000 Series).
    - b. Finish: Two (2) coats Pro Industrial Multi-Surface Acrylic Eg-Shel (B66-1560 Series).
  - 4. Gypsum Wallboard: Kitchens:
    - c. Primer: One (1) coat PVA Drywall Primer & Sealer (B28-8000 Series).
    - d. Finish: Two (2) coats Pro Industrial Multi-Surface Acrylic Eg-Shel (B66-1560 Series).

5. Primer Concrete and CMU: (Enamel):
    - a. One (1) coat ProMar Block Filler (AB25W25).
    - b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Semi-Gloss (B31W2651 Series).
  
  6. CMU: (Epoxy):
    - a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46)
    - b. Finish: Two (2) coats Pro Industrial Waterbased Epoxy, Eg-Shel (B66-1560 Series).
      - 1) Location: Kitchens, bathrooms, and laboratories.
- D. Paint Type 1: Refer to Drawings.

**END OF SECTION 09 90 00**

## **SECTION 10 01 00 - MISCELLANEOUS SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Furnish and install the following:
  - 1. Chain Hoist.

#### **1.3 RELATED SECTIONS**

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 20 00 - Unit Masonry.
- C. Section 05 50 00 – Metal Fabrications: Metal bracing, fasteners and other support components.
- D. Section 06 10 00 - Rough Carpentry: Wood blocking.
- E. Section 09 21 16 - Gypsum Board Assemblies.
- F. Section 09 51 00 - Acoustical Ceilings.
- G. Division 26 – Electrical Sections.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
  - 3. Manufacturer's operation and maintenance data, as applicable.
- B. Shop Drawings: Show sizes, locations and installation details. Include utility (electrical, water, gas) requirements.
- C. Samples: Color charts showing manufacturer's full range of colors.

#### **1.5 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 – Project Management and Coordination.

#### **1.6 COORDINATION**

- A. Coordinate Work of this Section with Work of other sections in which items are to be installed.

### **PART 2 - PRODUCTS**

#### **2.1 APPROVED MANUFACTURERS**

- A. Specifications are based on named products and manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

## **2.2 MATERIALS**

- A. Chain Hoist:
  - 1. Basis of Design: Model 2GTD7 as manufactured by Dayton.
  - 2. Load Capacity: 1000 lb.
  - 3. Hoist Lift: 20 feet.
  - 4. Voltage: 120 V, 20A, Phase 1.
  - 5. Finish: Powder Coat, Red.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify utility (electrical, water, and gas) requirements, where applicable, are installed and ready for connection.
- B. Verify items fastened to walls have proper blocking or support items installed.
- C. Verify locations for items are ready for their installation.

### **3.2 INSTALLATION**

- A. Install all items in accordance with manufacturer's printed instructions in locations shown on drawings or otherwise indicated.
- B. Provide blocking for LCD TVs mounting as indicated in drawings or per manufacturer's instructions.
- C. Install projection screen housing in conjunction with installation of ceiling system. After interior construction is essentially complete, install viewing surface and operating mechanism in housing. Install screens securely to supporting substrate so that screens are level and back of case is plumb. Provide required brackets, hanger rods, and fasteners.

### **3.3 CLEANING AND ADJUSTING**

- A. Make final adjustment after installation and clean all backstop support piping of dirt and other substances which may affect final finish.
- B. Clean all items of dirt and foreign matter which may affect appearance and operation.
- C. Adjust items for proper operation.
- D. Instruct Owner's personnel on proper operation and maintenance of items.

**END OF SECTION 10 01 00**

## **SECTION 10 11 00 – MARKERBOARD AND TACKBOARD**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Markerboards.
  2. Tackboard.
  3. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product including construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for units.
  1. Include electrical characteristics for motorized units.
- B. Shop Drawings: Submit plans, elevations, sections, details, and attachment to other work.
  1. Indicate sizes and layout, method of attachment, accessories, trim, details and finish.
  2. Show locations of panel joints. Show locations of field assembled joints for factory fabricated units too large to ship in one piece.
  3. Show locations and layout of special purpose graphics.
  4. Include sections of typical trim members.
  5. Include wiring diagrams for power and control wiring.
- C. Samples: Submit for each type of unit indicated.
  1. Markerboards and Tackboards: Not less than 8-1/2 inches by 11 inches (215 mm by 280 mm), with facing, core, and backing indicated for final work. Include one panel for each type, color, and texture required.
  2. Trim: 6 inch (150 mm) long sections of each trim profile.
  3. Display Rail: 6 inch (150 mm) long section of each type.
  4. Rail Support System: 6 inch (152 mm) long sections.
  5. Accessories: Full size Sample of each type of accessory.

#### **1.5 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  1. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame Spread Index: 25 or less.
    - b. Smoke Developed Index: 450 or less.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Accessibility Requirements: Comply with applicable requirements.
  - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
  - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
  - c. Texas Accessibility Standards (TAS) 2012.
- B. Installer Qualifications: Entity having minimum 5 years documented experience that employs installers and supervisors who are trained and approved by manufacturer.
- C. Source Limitations: Obtain each type of unit from single source from single manufacturer.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  1. Build mockup of typical shown on Drawings. Include accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at site.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver factory fabricated units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

#### **1.7 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with units by field measurements before fabrication.
  1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

#### **1.8 WARRANTY**

- A. Porcelain Enamel Face Sheets: Written warranty in which Manufacturer agrees to repair or replace porcelain enamel face sheets that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
    - c. Noticeable deterioration of finish.
    - d. Writing surface delamination.
    - e. Fabric discoloration, tearing, or delamination.
    - f. Unit releasing from substrate.

- B. Warranty Period: Minimum warranty of 50 years or for the life of the installation on porcelain enamel.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Porcelain Enamel Face Sheet: PEI-1002, with face sheet two or three coat process.
- B. High Pressure Plastic Laminate: NEMA LD 3.
- C. Natural Cork Sheet: Seamless, single layer, compressed fine grain cork sheet; bulletin board quality; face sanded for natural finish with surface burning characteristics indicated.
- D. Plastic Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- E. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd. (440 g/sq. m); with surface burning characteristics indicated.
- F. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with surface-burning characteristics indicated.
- G. Hardboard: ANSI A135.4, tempered.
- H. Particleboard: ANSI A208.1, Grade M-1.
- I. Medium Density Fiberboard: ANSI A208.2, Grade 130.
- J. Fiberboard: ASTM C 208 cellulosic fiber insulating board.
- K. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- L. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- M. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by unit manufacturer.
- N. Primer/Sealer: Mildew resistant primer/sealer recommended in writing by unit manufacturer for intended substrate.

### **2.2 MARKERBOARD AND TACKBOARD**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Arco Products, Inc.
  - 2. ABC School Equipment (Platinum Visual Systems).

3. ADP Lemco Incorporated, (ALinc).
  4. Best-Rite Manufacturing.
  5. Carolina Chalkboards Co.
  6. Claridge Products and Equipment, Inc.
  7. Ghent Manufacturing.
  8. Marsh Industries, Inc.
  9. Polyvision Corporation.
- B. Markerboard: Factory fabricated.
1. Basis of Design: Claridge LCS<sup>3</sup>
  2. Assembly: Indicated on Drawings.
  3. Corners: Square
  4. Width: As indicated on Drawings.
  5. Height: As indicated on Drawings.
  6. Mounting Method: Direct to wall, ensure wood blocking is provided in wall for mounting.
- C. Markerboard Panel: 24 gauge porcelain enamel steel LCS 24 face sheet on 7/16 inch MDF core with 0.015 inch aluminum back sheet.
1. Color: White.
  2. Magnetic.
- D. Tackboard Panel: Vinyl fabric faced panel on core indicated.
1. Basis of Design: Claridge Fabricork series #1550EW or comparable product.
  2. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
  3. Thickness: 1/2 inch (12.7 mm)
  4. Color and Pattern: Selected by Architect.
- G. Aluminum Frames: Fabricated from not less than 0.062 inch (1.57 mm) thick, extruded aluminum; standard size and shape
1. Basis of Design: Claridge Series 4 or comparable product
  2. Field Applied Trim: Snap on trim with no visible screws or exposed joints.
  3. Aluminum Finish: Clear anodic finish.
  4. Color and Pattern: Selected by Architect.
- H. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board as indicated on approved Shop Drawings.
- I. Combination Assemblies: Provide H trim between abutting sections of visual display panels.
- J. Marker Tray: Continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast aluminum end closures.
  2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- K. Display Rail: Extruded aluminum display rail with plastic impregnated cork insert, end stops, and continuous paper holder, designed to hold accessories.
1. Basis of Design Manufacturer/Product: Claridge 74 EZ Deluxe Map and Display Rail or comparable product.
  2. Size: 2 inches (50 mm).
  3. End Stops: Claridge 75ES or comparable product.
- L. Flag Holder: Claridge #76 FH or equal. Two for each room- total, not two per board.
- M. Flag Holders & Map Hooks:



1. For 16'-0" marker boards: Two (2) aluminum flag holders & four (4) aluminum map hooks.
2. For 8'-0" marker boards: Two (2) aluminum flag holders & four (4) aluminum map hooks.
3. For 4'-0" marker boards: Four (4) aluminum map hooks.

- N. Tackboard Insert Color: Selected by Architect.
1. Aluminum Color: Match finish of markerboards assembly trim.

### **2.3 FINISH REQUIREMENTS**

- A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Aluminum Finishes:
1. Dull satin anodized, natural.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the work.
- B. Examine roughing in for electrical power systems to verify actual locations of connections before installation of motorized, sliding units.
- C. Examine walls and partitions for proper preparation and backing for units.
- D. Examine walls and partitions for suitable framing depth where sliding units will be installed.
- E. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation. Clean substrates of substances, such as dirt, mold, and mildew, that impair the performance of and affect the smooth, finished surfaces of boards.
- B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between and wall surfaces.
1. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
  2. Prepare substrates indicated to receive glass writing surfaces required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.
    - a. Gypsum Board: Prime gypsum board with primer as recommended in writing by primer/sealer manufacturer and glass writing surface manufacturer.
    - b. Painted Surfaces: Treat areas susceptible to pigment bleeding.

- C. Prime wall surfaces indicated to receive units and as recommended in writing by primer/sealer manufacturer and unit manufacturer.
- D. Prepare recesses for sliding units as required by type and size of unit.

### **3.3 INSTALLATION**

- A. Install surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Install clear silicone caulk along entire top edge of all markerboards and tackboards where they meet the wall.
- C. Factory Fabricated Board Assemblies: Adhere to wall surfaces with egg size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.
  - 1. Field Applied Aluminum Trim: Attach trim over edges of boards and conceal clips. Attach trim to boards with fasteners at maximum 24 inches (610 mm) o.c.
  - 2. Mounting Height: Install units at mounting heights indicated on Drawings, or if not indicated, at heights indicated.
    - a. Mounting Height for Grades K through 3: 24 inches (610 mm) above finished floor to top of chalktray.
    - b. Mounting Height for Grades 4 through 6: 28 inches (711 mm) above finished floor to top of chalktray.
    - c. Mounting Height for Grades 7 and Higher: 36 inches (914 mm) above finished floor to top of chalktray.

### **3.4 CLEANING AND PROTECTION**

- A. Clean units according to manufacturer's written instructions. Attach one removable cleaning instructions label to unit in each room.
- B. Touch up factory applied finishes to restore damaged or soiled areas.
- C. Cover and protect units after installation and cleaning.

**END OF SECTION 10 11 00**

## **SECTION 10 14 00 - GRAPHICS**

### **PART 1 - GENERAL**

#### **1.0 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.1 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Panel signs.
  - 2. Room identification signs.
  - 3. Field applied, vinyl character signs.
  - 4. Cast character for exterior signage.
  - 5. Illegally Parking Signs in Accessible Spaces.
  - 6. Accessories necessary for a complete installation.
- B. Allowance: Signage is affected by allowances. Refer to Section 01 21 00.

#### **1.2 SUBMITTALS**

- A. Product Data: Technical data for each type of signage.
- B. Signage Shop Drawings: Submit fabrication and installation details and attachments to other Work.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Dedication Plaque Shop Drawings: Submit fabrication and installation details and attachments to other Work.
  - 1. Indicating materials, sizes, and finishes, details of fabrication and installation, fasteners and hardware, attachments, related and adjacent Work.
  - 2. Rubbing of actual pattern of cast metal plaque for Architect's approval prior to casting.
- D. Certifications: Submit letter of certification from manufacturer that installer and manufacturer is in compliance and meets specified requirements.
- E. Samples:
  - 1. One (1) 6 inch x 6 inch sample of cast metal plaque material with specified finish.

#### **1.3 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code/City Code: Comply with building code and local ordinances for exterior signage.
  - 2. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.

- B. Installer Qualifications: Installer has minimum 5 Years documented experience in the manufacture of signage and who employs installers and supervisors trained and approved in installation methods for each type of signage.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

#### **1.4 FIELD CONDITIONS**

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

#### **1.5 WARRANTY**

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Basis of Design Manufacturer: South Texas Graphics; (713) 467-4499. Other manufacturers shall have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified and shall comply with Division 1 requirements for substitutions in order to be considered.
  - 1. A.R.K. Ramos Architectural Signage Systems; (405) 235-5505.
  - 2. InPro Corporation (IPC); (800) 222-5566.
  - 3. ProWorx Architectural Signage; (713) 666-3131.
  - 4. LED Partners; (832) 479-1210.
  - 5. Riot Creative Imaging; (713) 988-9200.
  - 6. Stanley Signature Signs; (281) 395-6106.
  - 7. The Southwell Co.; (210) 223-1831.
- B. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- C. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- E. Acrylic Sheet: ASTM D 4802, category standard with manufacturer for each sign, Type UVF (UV filtering).

- F. Plastic Laminate Sheet: NEMA LD 3, general purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.
- G. Vinyl Film: UV resistant vinyl film of nominal thickness indicated, with pressure sensitive, permanent adhesive on back; die cut to form characters or images indicated and suitable for exterior applications.
- H. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.
- I. Accessories:
  - 1. Fasteners and Anchors: As necessary for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
    - a. Use concealed fasteners and anchors unless indicated to be exposed.
    - b. Exposed Metal Fastener Components: Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
  - 2. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
  - 3. Adhesive: Recommended by sign manufacturer.
  - 4. Two Face Tape: High bond, foam core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
  - 5. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187.

## 2.2 SIGNAGE

- A. General:
  - 1. Constructed of one (1) or two (2) high pressure laminate in colors selected by Architect / Owner, laminated to an 1/8" inch thick acrylic backer.
  - 2. Signage shall have radius or square corners with square cut edges painted a color as selected by Architect / Owner.
  - 3. Demarcation lines, if any, can be raised 1/32" inch to match copy or engraved and infilled with a color as selected by Architect / Owner.
  - 4. Signs shall comply with all state and federal codes, including but not limited to, the 2012 ADA and TAS requirements.
  - 5. Refer to drawings for details of types, dimensions, colors, graphic layouts and mounting/height specifications.
- B. Room Numbers, Symbols, Lower or Secondary Copy, and Pictograms:
  - 1. Copy shall be matte finished acrylic, raised 1/32" inch of a color contrasting to the face laminate.
  - 2. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion.
  - 3. Room numbers and restroom copy shall be accompanied by Grade II Braille by means of 'VisiTouch DuraDot System'. Glass or metallic 'DuraDots' shall have .059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.
  - 4. Secondary copy shall be a minimum of 5/8" inch high, matte finished acrylic, raised 1/32" inch sans serif font.
  - 5. Acceptable ADA compliant fonts are Arial, Helvetica, Optima, Futura as selected by Architect, in all caps.
  - 6. Plastic Laminate Schedule:
    - a. Room and Door Sign: RID-1

- 1) Basis of Design: Wilsonart.
- 2) Color: Silicon EV 4811-60.
- b. Room and Door Sign: RID-s
  - 1) Basis of Design: Wilsonart.
  - 2) Color: Silicon Titanium Alloy 5058K-18.
7. Add twenty (20) extra room signs to be placed by Architect.
- E. Laser Cut Aluminum Graphic:
  1. Aluminum Graphic.
  2. Graphic: Architect to provide vector file.
  3. Composition: Laser Cut.
    - a. 3 feet by 4 feet by 1/4 inch.
  4. Finish: Clear Anodized.
  5. Location: Mounted to Reception Wall. Refer to Drawings for exact location.
- F. Window (Slotted) Signs:
  1. Window / Slotted signs shall be open at both ends for changeable insert provided by Owner. Window shall be a non-glare Lexan acrylic lens, with an exposed color laminate behind in color as selected by Architect/Owner.
- G. Fasteners and Accessories:
  1. 1/8" inch thick, double-sided foam tape of type recommended to suite application and commercial grade silicone sealant.
  2. Back-up plates shall be supplied, when shown or required, for signage mounted on glass.
- H. Provide all materials required for a complete installation.
- I. Approved manufacturers:
  1. Signage:
    - a. Basis of Design: South Texas Graphic Specialties, Inc. Houston, TX 713.467.4499.
    - b. Refer to 2.1.A. of Section 10 14 00 for approved manufacturers.
  2. Plastic Laminate:
    - a. WilsonArt International, Temple, TX 800.433.3222
    - b. Nevamar Company, LLC, Shelton, CT 877.726.6526
    - c. Formica, 1.800.367.6422
    - d. Pionite, Shelton, CT 203.925.1556
- J. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles:
  1. Character Material: Cast aluminum alloy with satin polished faces and matte sides.
  2. Character Height: Indicated on Drawings.
  3. Finishes:
    - a. Clear anodized finish, bronze or Kynar finish as selected by Architect.
    - b. Color: As selected by Architect.
  4. Fasteners and Attachment Hardware: Concealed fasteners and hardware of size and type recommended by manufacturer for attachment of letters on wall.
  5. Provide all materials required for a complete installation.
  6. Typeface: Letters shall have a minimum of 12 inch high in Helvetica Medium upper case letters, unless shown otherwise. Architect shall provide a rendering of proposed building lettering for approval.
  7. Building Identification Sign:
    - a. Laser Cut Aluminum.
    - b. Finish: Powder Coat.
    - c. Color: Match Sherwin Williams Deep Maroon – SW0072.

- d. Thickness: 1/2 inch.
- e. Stand Offs: Concealed 3 inch.
- 8. Custom Logo:
  - a. Laser Cut Aluminum.
  - b. Thickness: 1/4 inch.
  - c. Stand Offs: Concealed 2 inch.
- K. Field Applied, Vinyl Character Sign: Prespaced characters die cut from 3 mil to 3.5 mil (0.076 mm to 0.089 mm) thick, weather resistant vinyl film with release liner on the back and carrier film on the front for on site alignment and application.
  - 9. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allen Markings.
    - b. APCO Graphics, Inc.
    - c. Mohawk Sign Systems.
    - d. Seton Identification Products.
  - 10. Size: Indicated on Drawings.
  - 11. Substrate: Indicated on Drawings.
- M. Illegally Parking Signs in Accessible Spaces:
  - Sign for Illegally parking in a paved accessible parking space.
  - 1. Minimum state "Violators Subject to Fine and Towing" in a letter height of at least one inch.
  - 2. Mounted on a pole, post, wall or freestanding board as shown on the Drawings.
  - 3. No more than eight (8) inches below a sign required by ADA and TAS standards.
  - 4. Installed so bottom edge of sign is no lower than 48 inches and no higher than 80 inches above ground level.
- N. Roof Access Signs:
  - 1. Signage material and attachment similar to Room identification signage.

## 2.3 FABRICATION

- A. Provide sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 5. Internally brace signs for stability and for securing fasteners.
  - 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing Work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
  - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

- B. Brackets: Fabricate brackets, fittings, and hardware for bracket mounted signs to suit sign construction and mounting conditions indicated. Modify brackets as necessary.
  - 1. Aluminum Brackets: Factory finish brackets with baked enamel or powder coat finish to match sign background color unless otherwise indicated.

## **2.4 FINISH REQUIREMENTS**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.
- E. Aluminum Finishes:
  - 1. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
  - 2. Baked Enamel or Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## **PART 3 - EXECUTION**

### **3.0 EXAMINATION**

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of signage Work. Verify sign support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- B. Proceed with installation after correcting unsatisfactory conditions.

### **3.1 INSTALLATION**

- A. Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
    - a. Comply with all applicable accessibility requirements for mounting height and location of each sign.
  - 4. Before installation, verify sign surfaces are clean and free of materials or debris that impair installation.
  - 5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.



- B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
  2. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
  3. Shim Plate Mounting: Provide 1/8 inch (3 mm) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.
- C. Field Applied, Vinyl Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

### **3.2 ADJUSTING AND CLEANING**

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION 10 14 00**

## **SECTION 10 21 13 – SOLID PLASTIC (HDPE) TOILET COMPARTMENTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Solid Plastic Core Toilet Partition, Floor Mounted and Overhead Braced.
  - 2. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Shop Drawings: Within four (4) weeks of award of contract, submit:
  - 1. Complete shop drawings for the Architect's approval, showing all required field measurements, all details and elevations, plans and sections required to indicate all conditions.
  - 2. Manufacturer's installation instructions.
- B. Samples: Submit for each type of unit with samples of hardware and accessories involving material and color selection.
- C. Certification: Provide a certificate of compliance attesting that all materials are in accordance with manufacturer's specifications.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
  - 2. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame Spread Index: 26 to 75.
    - b. Smoke Developed Index: 450 or less.
- B. Qualifications: Manufacturers must have a minimum of five (5) years of experience manufacturing.

#### **1.5 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

#### **1.6 MAINTENANCE MATERIAL**

- A. Furnish extra materials that match products installed and packaged with protective covering for storage and identified with labels describing contents and source.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch and keeper(s) with associated fasteners.
3. Door Bumper: One bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: Ten fasteners of each size and type.

## 1.7 WARRANTY

- A. Furnish twenty-five year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Solid Plastic (HDPE):
    - a. Accurate Partitions Corp.; ASI Group.
    - b. Scranton Products; Capitol Partitions, Comtec Industries.; (800) 445-5148.
- B. Aluminum Castings: ASTM B 26/B 26M.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- D. Stainless Steel Sheet: ASTM A 666, Type 304, stretcher leveled standard of flatness.
- E. Stainless Steel Castings: ASTM A 743/A 743M.

### 2.2 TOILET COMPARTMENTS

- A. Basis of Design: Hiney Hiders in 090 Black Paisley manufactured by Scranton.
- B. All toilet partitions shall be floor mounted and overhead braces.
- C. General: Comply with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS).
- D. Doors: 1/2 inch thick solid phenolic core with high pressure melamine color surface on faces. Edges shall be burnished and slightly rounded. Standard door size, other than "accessible", is 24 inches, unless indicated otherwise.
- E. Panels: 1/2 inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.
- F. Pilasters: Pilaster Shoes and Sleeves (Caps): Stainless steel.
  - a. Pilaster shall be attached to the floor by means of an 11 gauge stainless steel footer, with provisions for leveling, attached to two (2) 3/8 inch diameter stainless steel studs set into expansion shields. The floor connections are to be covered by a four (4) inch high stainless steel shoe, #4 finish.
  2. Option Panels: 1/2 inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.

- G. Headrail: Heavy duty aluminum extrusions, anodized with anti-grip configuration, and shall be fastened to the pilaster tops.
- H. Headrail Brackets: 16 gauge stainless steel.
- I. Hardware and Accessories: Heavy duty operating hardware and accessories.
  - 1. Hinges: 14-gauge continuous piano, self-closing hinge. Continuous piano hinge shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable.
  - 2. Latch and Keeper: Heavy duty surface mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
  - 3. Coat Hook: Heavy duty combination cast stainless steel hook and rubber tipped bumper, sized to prevent in swinging door from hitting compartment mounted accessories. Mount with through bolts.
  - 4. Door Bumper: Heavy duty rubber tipped cast stainless steel bumper at out swinging doors and entrance screen doors. Mount with through bolts.
  - 5. Door Pull: Heavy duty cast stainless steel pull at out swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.
  - 6. Door Latch Housing: Shall be fabricated from heavy aluminum extrusion with clear anodized finish, surface mounted and thru-bolted to door with one-way sex bolts. Slide bolt and button shall be heavy duty aluminum finish.
- J. Finish: Melamine color surface on material face, edges burnished. All wood grain panels larger than 57-1/4 inches will have horizontal grain.
- K. Color: 090 Black Paisley.

### **2.3 DRESSING ROOM / SHOWER STALL COMPARTMENTS**

- A. Basis of Design: Products manufactured by Scranton.
- B. General: Comply with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS). Provide HDPE material seats at ADA shower sized to ADA requirements.
- C. Curtain Rod and Head Rails: Aluminum with anti-grip (2 per stall).
- D. Curtains: Heavy duty, 8-gauge vinyl (2 per compartment/ dressing and Shower). Curtain is to be an anti-microbial type.
- E. Doors: 1/2 inch thick solid phenolic core with high pressure melamine color surface on faces. Edges shall be burnished and slightly rounded. Standard door size, other than "accessible", is 24 inches, unless indicated otherwise.
- F. Panels: 1/2 inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.
- G. Curtains: heavy duty, 8 gauge vinyl (2 per compartment/ dressing & shower. Anti-Micorbial type curtain.
- H. Soap dish: Chrome plate.

- I. HDPE Bench Top:
  - 1. 1 inch thick HDPE locker bench top with CMU base; 30-36 inches on center.
  - 2. Edge: Radiused Top, 1-1/2 inch.
  - 3. Color: Paisley.
  - 4. Texture: Orange Peel.
  
- J. ADA HDPE Bench Top:
  - 1. 1 inch thick HDPE locker benches top with CMU base; 30-36 inches on center.
  - 2. Edge: Radiused Top, 1-1/2 inch.
  - 3. Color: Paisley.
  - 4. Texture: Orange Peel.
  
- K. HDPE Countertop:
  - 1. 1 inch thick HDPE countertop with CMU base; 30-36 inches on center.
  - 2. Edge: Radiused Top, 1-1/2 inch.
  - 3. Color: Paisley.
  - 4. Texture: Orange Peel.
  
- L. Pilasters: Pilaster Shoes and Sleeves (Caps):
  - a. Provide two sets of 1 inch thick HPDE pilasters. One set between the dressing and shower compartments. The second set shall be placed at the end of the dressing compartments. Head rail with integral curtain track shall be mounted continuously at the tops of each pilaster,
  
- M. Headrail: heavy duty aluminum extrusions, anodized with anti-grip configuration, and shall be fastened to the pilaster tops.
  
- N. Hardware and Accessories: Heavy duty operating hardware and accessories.
  - 1. Hinges: 16-gauge continuous piano, self-closing hinge. Continuous piano hinge shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable.
  - 2. Latch and Keeper: Heavy duty surface mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
  - 3. Coat Hook: Heavy duty combination cast stainless steel hook and rubber tipped bumper, sized to prevent in swinging door from hitting compartment mounted accessories. Mount with through bolts. Provide two (2) hooks at panels in dressing compartments.
  - 4. Door Bumper: Heavy duty rubber tipped cast stainless steel bumper at out swinging doors and entrance screen doors. Mount with through bolts.
  - 5. Door Pull: Heavy duty cast stainless steel pull at out swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.
  - 6. Fasteners: Vandal-proof stainless steel.
  
- O. Finish: Melamine color surface on material face, edges burnished. All wood grain panels larger than 57-1/4 inches will have horizontal grain.
  
- P. Color: 090 Black Paisley.
  
- Q. Texture: Orange Peel.

## **2.4 PARTITION COMPONENTS**

- A. Mounting:
  - 1. Urinal Screen Style: Wall mounted.
  - 2. Toilet Partition: Floor anchored and overhead braced.
  - 3. Dressing Room and Shower Stall: Floor anchored and overhead braced..

## **2.3 FABRICATION**

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead Braced Units: Provide corrosion resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor Anchored Units: Provide corrosion resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Urinal Screen Posts: Provide corrosion resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.
- E. Door Size and Swings: Unless otherwise indicated, provide 24 inch (610 mm) wide, in swinging doors for standard toilet compartments and 36 inch (914 mm) wide, out swinging doors with a minimum 32 inch (813 mm) wide, clear opening for compartments designated as accessible.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's printed instructions.
- B. Install all toilet partitions where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for long life under hard use and in complete accordance with the manufacturer's recommendations.
- C. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.

### **3.2 CLEANING AND ADJUSTING**

- A. Clean surfaces free of dirt, oil, grease and other contaminants which detract from appearance of partitions.
- B. Except for compartments for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

### **3.3 REPLACEMENT OF DEFECTIVE MATERIALS**

- A. Defaced, damaged, scratched or marred materials will not be permitted, will be considered defective, and rejected. Rejected materials shall be replaced with new materials at no additional expense to Owner.

**END OF SECTION 10 21 13**

## **SECTION 10 22 13 - WIRE MESH PARTITIONS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Show plan and elevation of each partition, with verified dimensions, partition construction, anchorage details, door details, hardware schedule, and finishes.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Any one (1) of the manufacturer's listed who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Acorn Wire and Iron Works, Inc.; (800) 552-2676.
  - 2. California Wire Products Corp.; (877) 214-4078.
  - 3. G-S Company Wire & Iron Works.; (410) 284-9549.
  - 4. Indiana Wire Product.; (800) 451-0406
  - 5. Standard Wire & Steel Works.; (708) 333-8300
  - 6. Superior Wire and Metal Products, Inc.; (567) 331-0544.
  - 7. Central Wire & Iron Works.; (515) 244-2532

#### **2.2 MATERIALS**

- A. Wire Mesh Partitions:
  - 1. Mesh: 1-1/2 inch diamond mesh of not less than 10-gauge wire complying with ASTM A510.
  - 2. Intermediate Bars: Pair of 1 inch by 1/2 inch by 1/8 inch cold rolled channels bolted together, allowing mesh to pass.
  - 3. Vertical Frames: pair of 1-1/4 inches by 5/8 inch "C" channels with I-beam stiffeners of 5/16 inch x 2 inch bars.
  - 4. Horizontal Frames: Pair of 1 inch by 1/2 inch x 1/8 inch channels.
  - 5. Top Caps: 2-1/4 inches by 1 inch cold rolled channels.
  - 6. Head Track (sliding): With four (4) wheel ball bearing trucks.
  - 7. Erection Hardware: As necessary to secure and complete the installation.
  - 8. Floor Shoes: Weldable ductile iron, 1-1/4 inches high, with set screw adjustment.
  - 9. 1-1/2 inch diameter galvanized steel handrail verticals and horizontals with mesh panel inserts as shown on drawings.
  - 10. Horizontal Bracing: Provide at wall as needed a to produce strong durable installation.
- B. Wire Mesh Doors: Provide sliding doors at the dimensions and arrangements shown on the drawings and the following features. Provide swing type doors as indicated on the drawings.

1. Framing: 1-1/4 inch x 1/2 inch by 1/8 inch hot rolled channels, with 1-1/4 inches by 1/8 inch flat bar cover on three (3) sides.
  2. Provide 1-3/8 inches by 3/4 inch by 1/8 inch angle riveted to lock sides.
  3. Provide continuous head track and wheel trucks
  4. Provide a continuous 12 gauge strike bar
  5. Provide cylinder locks at swing gates and sliding doors. Locks shall be master keyed to MARKS reversible gate locks and lever inside (# W-3791).
- C. Finish: Provide shop applied prime coat of rust-inhibitive paint compatible with the finish coat provided under Section 09 91 00.
- D. Miscellaneous Materials: provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

### **PART 3 - EXECUTION**

#### **3.1 SURFACE CONDITIONS**

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

#### **3.2 INSTALLATION**

- A. Install the Work of this Section in accordance with the manufacturer's recommendations and shop drawings as approved by the Architect, anchoring all components firmly into position, true to line, and aligned horizontally and vertically within a tolerance of one in 500.
- B. Adjust operating components for optimum smooth function.

**END OF SECTION 10 22 13**



## **SECTION 10 26 00 – WALL AND DOOR PROTECTION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 WORK INCLUDED**

- A. Furnish and install impact-resistant wall covering at stairs and where shown on drawings.

#### **1.3 REFERENCES**

- A. Publications listed herein are part of this specification to the extent referenced. The criteria established in the specifications shall take precedence over the standards referenced herein. (Examples of reference standards are given below.)
  - 1. ASTM International (ASTM):
    - a. D 256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
    - b. E 84, Standard Test Method for Surface Burning Characteristics of Building Materials

#### **1.4 SYSTEM DESCRIPTION**

- A. Wall Protection systems shall be for interior applications.
  - 1. Semi-rigid, integrally-colored sheet wall covering over gypsum wallboard at stairs and where shown on drawings.

#### **1.5 QUALITY ASSURANCE**

- A. Manufacturer: Furnish assemblies from one (1) manufacturer with a minimum of ten (10) years of experience in the fabrication of wall protection systems.
- B. Installer: Firm with not less than three (3) years of successful experience in the installation of systems similar to those required by this project and acceptable to the manufacturer of the system.

#### **1.6 SUBMITTALS**

- A. Submit manufacturer's specifications and technical data, including Material Safety Data Sheets, installation instructions, as required, and catalog cuts and templates where required to explain construction and to provide for incorporation into the project.
- B. Submit certificates, copies of independent test reports or research reports showing compliance with specified performance requirements.
- C. Submit shop drawings showing complete fabrication details for wall protection, including required anchorage to surrounding construction.
- D. Submit three (3) 6 inch samples of the specified system.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Provide temporary protective cover on [stainless steel] [phosphatized steel] finished surfaces.
- B. Deliver wall protection systems to the jobsite in new, clean, unopened crates of sufficient size and strength to protect materials during transit.
- C. Store components in original containers in a clean, dry location.

## 1.8 WARRANTY

- A. Submit manufacturer's warranty that materials furnished will perform as specified for a period of not less than five (5) years when installed in accordance with manufacturer's recommendations.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on Interior Products manufactured by Koroseal Wall Protection Systems, Muncy, PA; (800) 628-0449. Manufacturers listed below whose product meets or exceeds the specification are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Acrovyn Wall and Door Protection

### 2.2 MATERIALS

- A. Vinyl Corner Guard:
  - 1. Basis of Design: Korogard -G400 Wallcoverings manufactured by Koroseal
  - 2. Vinyl Corner Guard.
  - 3. Material: Vinyl.
  - 4. Wings: 2-11/16 inches.
  - 5. Corner: 1-1/4 inch radiused.
  - 6. Height: As indicated on Drawings.
  - 7. Mounting: Continuous Aluminum Retainer.
  - 8. Comply with fire performance characteristics of Flame Spread of 25 or less and Smoke Developed of 450 or less and be chemical- and stain resistant.
  - 9. Color and pattern shall be as selected by Architect from manufacturer's standard colors and patterns.
- B. Accessories and other materials required for complete installation to manufacturer's instructions.

### 2.3 FABRICATION

- A. Fabricate wall protection materials as detailed. Provide accessories necessary for complete installation. Mounting brackets and end returns shall be injection molded.
- B. Shop assemble components to the greatest extent possible.
- C. Provide components in single lengths where possible; minimize site splicing.
  - 1. Wall protection materials shall be provided cut to length.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Installer shall examine conditions under which work is to be performed and shall notify the General Contractor of unsatisfactory conditions in writing.
- B. Examine areas and conditions in which wall surface protection components and wall protection systems will be installed.
- C. Complete finishing operations, including painting, before beginning installation of wall surface protection system materials.
- D. Wall surfaces to receive impact-resistant wall covering materials shall be dry and free from dirt, grease, loose paint, and scale.
- E. Do not proceed with installations until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

#### **3.2 PREPARATION**

- A. Properly prepare substrate and clean to remove dust, debris, and loose particles.

#### **3.3 INSTALLATION**

- A. Install wall surface protection units plumb, level, and true to line without distortions in accordance with manufacturer's instructions.
- B. Do not use materials with chips, cracks, voids stains, or other defects that might be visible in the finished work.
- C. Install installation accessories in accordance with manufacturer's instructions.
- D. Manufacturer shall provide location drawings identifying placement of materials, and shall use a mark system for correlating materials to drawings.
- E. Work shall be aligned, as required, flush with adjacent surfaces.
- F. Work shall be rigidly anchored to the substrate.

#### **3.4 CLEANING AND PROTECTION**

- A. Clean wall covering and accessories in accordance with manufacturer's instructions.
- B. Remove excess adhesive using methods and materials recommended by the manufacturer.
- C. Advise the Contractor of procedures required to protect the installation from damage by the work of other sections.
- D. Finished units shall be without damage. Units damaged during shipping or construction shall be repaired by the Contractor at the expense of the party damaging the material, in accordance with the contract requirements.

**END OF SECTION 10 26 00**

## **SECTION 10 28 13 - TOILET ROOM ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Toilet accessories; shower accessories; and utility room accessories.

#### **1.3 RELATED SECTIONS**

- A. Section 04 20 00 – Unit Masonry.
- B. Section 05 40 00 – Cold-Formed Metal Framing.
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Section 09 30 00 – Tiling.
- E. Section 10 21 13 - Toilet Compartments.
- F. Division 26 – Electrical.

#### **1.4 OWNER FURNISHED CONTRACTOR INSTALLED ITEMS**

- A. The Owner shall furnish the following items to the Contractor in a timely basis for installation into the work:
  - 1. Soap Dispensers (TA-1).
  - 2. Toilet Tissue Dispensers (TA-3).
  - 3. Paper Towel Dispenser (TA-4).
- B. Contractor shall furnish and install the following items to the Contractor:
  - 1. Mirrors (TA-2).
  - 2. Grab Bars (TA-5, TA-9 & TA-15).
  - 3. Sanitary Napkin Dispenser (TA-6).
  - 4. Sanitary Napkin Disposal (TA-7).
  - 5. Mop and Broom Holder (TA-8).
  - 6. Clothes Hook (TA-11).
  - 7. Shower Curtains, Rods and Hooks (TA-12).
  - 8. Electric Hand Dryers (TA-13).
  - 9. Diaper Changing Stations (TA-16).
  - 10. Stainless Steel Wainscot Panels (TA-17).

#### **1.5 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and technical data.
  - 2. Manufacturer's installation instructions.
  - 3. Manufacturer's operation and maintenance instructions of units specified.
  - 4. Provide schedule of materials and installation locations.

- B. Shop drawings: Indicate size, material and finish. Show locations, installation procedures. Include details of joints, attachments, fasteners, clearances, and mounting heights.

#### **1.6 MINIMUM COMPLIANCE STANDARDS**

- A. Comply with ANSI A117.1 and Texas Accessibility Standards (TAS) and with referenced standards specified with each product or material.

#### **1.7 QUALITY STANDARDS**

- A. Design, finish and keying of items shall be the same.
- B. Furnish items from one (1) manufacturer only unless otherwise specified or directed by Architect.

#### **1.8 PRE-INSTALLATION CONFERENCE**

- A. Refer to Section 01 31 00 – Project Management and Coordination.

#### **1.9 COORDINATION**

- A. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

#### **1.10 WARRANTY**

- A. Warrant the work specified herein for three (3) years, or provide manufacturer's standard warranty for specified products, against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
  - 1. Delamination or deterioration of finish
  - 2. Noisy, rough or difficult operation
  - 3. Failure to meet specified quality assurance requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceeds the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. A & J Washroom Accessories.; (845) 562-3332
  - 2. American Specialties, Inc. (ASI).; (914) 476-9000.
  - 3. Bobrick Washroom Equipment, Inc.:(682) 207-4141.
  - 4. Bradley Corporation.; (800) 272-3539.
  - 5. General Accessory Mfg. Co. a division of Bobrick. (682) 207-4141.
  - 6. McKinney Door & Hardware, Inc. (719) 543-3124.
  - 7. GAMCO, General Accessory Mfg. Co.,(580) 924-8066.

#### **2.2 COMPONENTS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.
  - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

- B. Stainless Steel:
  - 1. Stainless Steel Sheet: ASTM A666 Type 302 or 304.
  - 2. Stainless Steel Tubing: ASTM A269, stainless steel.
  - 3. Finish: No. 4 satin, unless otherwise specified
  - 4. Thickness: 22 US Stainless gauge minimum
- C. Chromium Plating:
  - 1. Method: Over nickel
  - 2. Standard: ASTM C456, Type SC 2
- D. Mirrors (Framed):
  - 1. Standard: FS DD-G-451-C, silvering quality No. 1 float or plate
  - 2. Thickness: 1/4 inch
  - 3. Backing: Electrolytic cooper
  - 4. Protection: Padding and filler strips
- E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.
- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.
- G. Backing: concealed backing to comply with local codes and as required for substrate conditions; or manufacturer's standard mounting kits.

## 2.3 FINISHING

- A. Stainless Steel: No. 4 satin brushed, typical on all accessories, unless otherwise noted.  
  
Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats vitreous enamel.
- B. Chrome/Nickel Plating: Satin finish.
- C. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.

## PART 3 - EXECUTION

### 3.1 MOUNTING LOCATIONS

- A. Comply with ADA and TAS requirements. Refer to drawings. When not shown, submit supplier's recommendations for locations and mounting height before proceeding.
- B. Contractor shall be responsible for supplying all opening, blocking, and other components necessary for installation of all toilet accessories.
- C. Use approved theft-resistant type fasteners.
- D. All dispensers shall be installed and fastened securely to walls with anchors suitable for back-up materials or finish as scheduled. (Not supported by double-sided tape)

### 3.2 SCHEDULE

WASHROOM EQUIPMENT

1. TA-1 - Soap Dispensers: **OFCI**
  - a. Mounting: Surface.
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model No.: B-2112.
  - d. Locations: One (1) at each lavatory. Refer to drawings.
  
2. TA-2 - Mirrors:
  - a. Mounting: Surface.
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model No.: B-290.
  - d. Size/Locations: 24 inches x 36 inches, unless shown otherwise. One (1) at each lavatory. Refer to drawings.
  
3. TA-3 - Toilet Paper Dispenser: **OFCI**
  - a. Mounting: Surface.
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model No.: Kimberly Clark 09507.
  - d. Locations: One (1) at each water closet. Refer to drawings.
  
4. TA-4 - Paper Towel Dispenser: **OFCI**
  - a. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - b. Model No.: Baywest 86500.
  - c. Locations: One (1) at each lavatory. Refer to drawings.
  
5. TA-5 - Grab Bars: (At Typical Accessible Toilet Stalls)
  - a. Size/Finish: 1-1/2 inch diameter Satin Finish Stainless Steel.
  - b. Clearance: 1-1/2 inch between rail and wall.
  - c. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - d. Model No.: B-6806.
  - e. Mounting: Attach with concealed mounting. Mount parallel to floor.
  - f. Location: One (1) 36 inch behind toilet, and one (1) 42 inch long bar at side of toilet, at each accessible stall. Refer to drawings & comply with ADA requirements.
  
6. TA-6 - Sanitary Napkin Dispenser:
  - a. Mounting: Surface
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model No.: B-2800
  - d. Operation: Single coin - (25 cents)
  - e. Capacity: 31 Napkins/ 22 Tampons
  - f. Locations: One (1) at each Women's toilet room. Refer to drawings.
  
7. TA-7 - Sanitary Napkin Disposal:
  - a. Mounting: Surface.
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model No.: B-2800.
  - d. Operation: Single Coin (25 Cents).
  - e. Capacity: 31 Napkins/ 22 Tampons.
  - f. Provide four (4) dozen liner units.
  - g. Locations: One (1) at each Women's toilet room. Refer to drawings.
  
8. TA-8 Mop and Broom Holder:
  - a. Mounting: Surface
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.

TOILET ROOM ACCESSORIES

- c. Model No.: B-223 x 36
  - d. Capacity: Five (5) Holders.
  - e. Location: One (1) above mop sink at each custodial room whether indicated or not. Refer to drawings.
9. TA-9 - Grab Bars: (At Accessible Shower)
- a. Mounting: Surface
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model: B-6861 modified (24 x 16)/ B-6806 x 36 inches.
  - d. Location: One (1) at each accessible shower stall. Refer to drawings.
10. TA-10 - Folding Bench: **(NOT USED)**
11. TA-11 - Clothes Hook:
- a. Mounting: Surface
  - b. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - c. Model No.: B-6717; or equivalent.
  - d. Location: One (1) hook inside door at single toilet rooms, and one (1) hook at each shower location if not included in partition package described below, unless noted otherwise.
  - e. Toilet and Shower Partitions: hook provided by toilet partition manufacturer included in standard hardware package in accordance with Section 10 21 13.19 – Toilet and Shower Partitions; unless noted otherwise.
12. TA-12 - Shower Curtains, Rods and Hooks:
- a. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - b. Model Nos.:
    - 1) Rods: B-6047 (36 inches or as indicated)
    - 2) Curtains: 204-2 (42 inches x 72 inches or as required)
    - 3) Hooks: 204-1 (Seven (7) hooks per curtain or as required)
    - 4) Mounting/Location: One (1) at each accessible shower. Refer to drawings.
13. TA-13 - Electric Hand Dryers:
- a. Mounting: Surface mounted.
  - b. Manufacturer: Bradley Corporation.
  - c. Model No.: 2902-28000.
  - d. Locations: Refer to drawings.
14. TA-14 - Paper Towel Dispenser / Trash Receptacle Combination **(NOT USED)**
15. TA-15 - Grab Bars: (At Additional Accessible Toilet Stalls)
- a. Size/Finish: 1-1/2 inch diameter Satin Finish Stainless Steel.
  - b. Clearance: 1-1/2 inch between rail and wall.
  - c. Manufacturer: Bobrick Washroom Equipment, Inc., (281) 362-7515.
  - d. Model No.: B-6806.
  - e. Mounting: Attach with concealed mounting. Mount parallel to floor.
  - f. Location: One (1) 36 inch at each side of toilet, at each accessible stall. Refer to drawings.
16. TA-16A - Diaper Changing Stations: **(NOT USED)**
17. TA-18: Vertical Grab Bar:
- a. Model: B6806 x 18.
  - b. Manufacturer: Bobrick.
  - c. Locations: Refer to Drawings.



**END OF SECTION 10 28 13**

## **SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Fire extinguisher.
  2. Extinguisher cabinet.
  3. Fire Hose and Valve Cabinets.
  4. Defibrillator (AED) Cabinet.
  5. Brackets.
  6. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- A. Product Data:
  1. Manufacturer's specifications and technical data to indicate specification compliance.
  2. Manufacturer's installation instructions.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Specifications are based on the products of named manufacturers. Other listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  1. Larsen's Manufacturing Co.
  2. J. L. Industries, Inc.; (800) 554-6077
  3. Potter-Roemer.; (800) 366-3473

#### **2.2 MATERIALS**

- A. Fire Extinguisher Cabinets (FEC):
  1. Size: 24 inches x 9-1/2 inches x 6 inches inside tub dimension.
  2. Type: Semi-recessed with 2-1/2 inch return trim rolled edge; ADA compliant.
  3. Tub Construction: 22 gauge min. steel with standard baked acrylic enamel interior finish.
  4. Door and Frame: 18 gauge min. 304 stainless steel door and frame with vertical decal lettering "FIRE EXTINGUISHER" in red color, unless directed otherwise by Architect.
  5. Glazing: clear acrylic "Duo" vertical glazing panel
  6. Hardware: Continuous concealed piano hinge constructed of material which matches door and trim material. Satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle (Larsen's "Larsen-Loc"™, J.L. Industries "Saf-T-Lok"™; or equivalent).
  7. Bracket: Hook type; Larsen's #546, or equal.
  8. Finish of Exterior: #4 Stainless steel.

9. Fire rating: as occurs, provide fire rated cabinet, for one or two hour rated conditions as indicated or required by specific location. Cabinet shall be tested and approved by Warnock Hersey to ASTM E-814, and shall bear the Warnock Hersey label.
  
- B. Fire Extinguishers (F.E):
  1. Models/Types:
    - a. Multipurpose dry chemical with 10 lbs. capacity and UL 4A-80B:C rating conforming to MP10 Series.
    - b. Wet chemical (Potassium Acetate) with 6 liter, Class A, Type K for kitchen use.
  2. Mounting: Provide eye brackets for direct wall mounting to hook and for mounting in Fire Extinguisher cabinets. Refer to drawings for location and quantity.
  3. Provide initial inspection tag for each extinguisher.
  
- C. Fire Hose and Valve Cabinets:
  1. Basis of Design Model: VCSS 1818-R as manufactured by Larsen's Manufacturing Company or comparable product approved by Architect.
  2. Dimensions: 1
    - a. Inside Box: 18 inches H x 18 inches W x 8 inches D.
  2. Cabinet Style: Architectural.
  3. Fire Rated: No.
  4. Door Frame: Steel.
  5. Trim: Trimless.
  6. Accessories: 2.5 inch Fire Dept. Valve with Cap and Chain.
  
- D. Defibrillator (AED) Cabinet (for Owner-furnished AED):
  1. Basis of Design: J. L. Industries, Inc. 1400 Series steel cabinet.
  2. Mounting: Fully or semi-recessed, as indicated on drawings. Surface mounted units are not acceptable.
  3. Door: Fully glazed with acrylic glazing, continuous hinge, "AED" and symbolic heart graphics, roller catch, and plated metal handle.
  4. Alarm: Battery-operated, with on/off key switch on exterior of cabinet.
  5. ADAC-compliant.
  6. Size: Large enough to accommodate most AEDs, but at least 14 inches x 14 inches by 7 inches deep net inside dimensions.
  7. Finish: White powder coat.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install fire extinguishers and cabinets in openings in accordance with manufacturer's printed instructions.
- B. Install fire extinguishers and cabinets where indicated on the drawings, or if not indicated, in locations required by governing code and as directed by Owner.
- C. Provide five (5) additional fire extinguishers to be installed at locations determined by Fire Marshall.

**END OF SECTION 10 44 00**

## **SECTION 10 51 13 - METAL LOCKERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Welded corridor lockers.
  - 2. Accessories necessary for a complete installation.

#### **1.3 SUBMITTALS**

- B. Product Data:
  - 1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
  - 2. Manufacturer's installation instructions.
- C. Shop Drawings: Indicate size, material, and finish. Show location and installation procedures. Include details of joints, attachments and clearances.
- D. Locker/Lock Schedule: Manufacturer shall furnish the Owner prior to Substantial Completion in a schedule for all lockers. The schedule shall contain the locker number, serial number of the lock installed, key number, or combinations, as applicable, for each locker. Furnish the schedule in spreadsheet form, i.e. Excel, etc. Furnish schedule in three (3) hard copied and flash drive. This information is to be transmitted to CFISD Maintenance Department. Do not distribute to campus staff.
- E. Sample: Provide half size locker samples to Architect for approval showing all fasteners and door types for locks.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Accessibility Requirements: Comply with applicable requirements.
    - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
    - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
    - c. Texas Accessibility Standards (TAS) 2012.
- B. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.
  - 1. Obtain locks from single lock manufacturer.
- C. Preinstallation Conference: Conduct conference at site.

#### **1.5 WARRANTY**

- A. Warrant the work specified herein for ten (10) years.
- B. Defects shall include, but not be limited to, the following:

1. Rapid deterioration of finish.
2. Loose or missing parts.
3. Non-functioning components and mechanisms.
4. Rust, delamination, warp, rot or breakage.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Art Metal Lockers (AMP); (954) 429-9155.
  2. DeBourgh Manufacturing Co., LaJunta, CO; (800) 328-8829
  3. Republic Storage Systems Co., Inc., Canton, OH; (800) 477-1255.
  4. Art Metal Products Company.
  5. Lyon Metal Products.
  6. Penco Products, inc.
  7. Interior/ Medart.
- B. Basis of Design: Specification is based on products manufactured by AMP.
- C. Locker: All welded construction.
1. Material: Prime, high grade Class I mild annealed, cold-rolled steel.
  2. General Construction: Pre-assembled, welded seams and joints. Bolts, screws or rivets used in the assembly of the locker bodies are not permitted. Welds shall be free of burrs.
  3. Body: 16 gauge, flanged.
  4. Backs: 18 gauge, one-piece
  5. Door Frame: 16 gauge, channels or angles, with continuous door strike. Multiple tiered assemblies shall have intermediate cross frame welded to vertical framing members.
  6. Door: 14 gauge formed door constructed of single piece cold rolled steel. Full channel shaped on lock side, formed channel formation on hinge side, right angle shaped on horizontal sides. Athletic Area door to have expanded doors.
  7. Ventilation: Six (6) louvers per door, top and bottom, minimum 7 percent ventilation.
  8. Hinges: Two (2) inches high minimum, five (5) knuckle, full loop, tight pin. Weld to door and frame. Two (2) per door for lockers 42 inches high or less; three (3) per door for lockers over 42 inches high.
  9. Latching: one-piece, pre-lubricated spring steel, completely contained within the lock bar under tension to provide rattle-free operation. Provide three (3) latching points for lockers over 42 inches in height and two (2) latching points on for all tiered lockers 42 inches and under in height.
  10. Pre-Locking Device: Lockers shall be equipped with a positive automatic pre-locking device whereby the locker may be locked while the door is open and then closed without unlocking and without damaging the locking mechanism.
  11. Handles: Recessed, stainless steel with non-protruding lifting trigger.
  12. Number Plates: Aluminum with etched figures at least 3/8 inches high, attached near top of door with two (2) aluminum rivets. Number plates shall be in order as directed by the Architect.
  13. Finish: Baked enamel. Colors shall be as selected by Architect from manufacturer's standard colors. Lockers shall be painted inside and outside with the same color.
  14. Fasteners/Anchors: Provide fasteners and anchors of type, size and finish as recommended by manufacturer for attaching or anchoring lockers to walls and floor.
  15. Free-Standing Lockers: Provide front and end closed bases.
  16. Base: Lockers shall rest on bases as detailed on drawings.
  17. Locks: Utilize Master 1630 lock and Master 1636 for ADA locks. Provide 10 copies of ADA key for each ADA lock. ADA Master key shall match existing ADA master key on campus, if applicable. If no ADA master key can be identified a new key number may be

introduced into the locker key system (verify number with the Maintenance Department.)  
Locks at P.E. area lockers to be Master 1654 Locks.

18. Top Closures, Closure Strips, and Fillers: Provide where shown, factory fabricated and finished to match lockers, unless noted otherwise.
19. Hooks to be included in Athletic area lockers.

- D. Accessible Student Locker: Accessible lockers with recessed handles, single tier or the lower opening of double tier locker. Locker bottom shall be a minimum of 15 inches off the floor, or an extra shelf placed 15 inches off the floor with bottom or shelf turned down to close resultant opening.

### **2.3 LOCKER TYPES**

- A. Type 'A': Four Tier, 12 inches Wide by 12 inches High by 15 inches deep.
- B. Type 'B': Double Tier, 18 inches Wide by 36 inches high by 21 inches deep.
- C. Type 'C': Single Tier, 12 inches Wide by 60 inches High by 18 inches deep.

### **2.4 OTHER MATERIALS:**

- A. Locker Tops for all lockers not located against a wall:
  1. Basis of Design: Scranton Products.
  2. Color: Paisley
  3. Texture: Orange Peel.
  4. Thickness: 1 inch.
  5. Radiused Edge: 1-1/2 inch.
- B. Provide other materials, not specifically described but required for a complete and proper locker installation.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Assemble and install lockers plumb, level, and flush in the locations shown on the drawings in accordance with the manufacturer's instructions. Lockers shall have no sharp metal edges.
- B. Install and anchor lockers to the floor and wall as instructed by the manufacturer.
- C. Install sloping hoods, metal fillers, end panels and trim to close openings, and accessories where shown on drawings or required to complete installation. Install using concealed fasteners. Provide flush hairline joints against adjacent surfaces.
- D. Ensure number plates are installed in order directed by the Architect.
- E. All Locker codes, combo disks and keys are to be delivered to Owner appointed representative.

### **3.2 ADJUST AND CLEAN**

- A. Adjust doors and latches to operate without binding and positive latching and automatic locking.
- B. Touch up marred finishes on lockers with manufacturer's supplied paint.

**3.3 OWNER STOCK**

- A. Provide 25 additional locks of each non-ADA type locks installed.
- B. Provide 10 additional ADA locks.
- C. Include keys for all owner stock locks.

**END OF SECTION 10 51 13**

## **SECTION 10 56 13 - METAL STORAGE SHELVING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  1. Four post metal storage shelving.
  2. Accessories necessary for a complete installation.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of shelving unit and accessory components including recessed tracks. Include rated capacities, installation and construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Submit plans, elevations, sections, and details, including installation details of connectors, lateral bracing, and special bracing.
- C. Seismic Qualification Certificates: For metal storage shelving, accessories, and components, from manufacturer.

#### **1.5 COORDINATION**

- A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.
- B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

#### **1.6 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants during the remainder of the construction period.



## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- C. Metallic Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating.
- D. Steel Tubing: ASTM A 513, Type 2.

### **2.2 STORAGE SHELVING UNITS**

- A. Four Post Metal Storage Shelving:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dixie Shelving Co,
    - b. Lyon Workspace Products, LLC.
    - c. Montel. Inc.
    - d. Republic Storage Systems Co.
    - e. Inco Metal Products.
    - f. List Industries.
  - 2. Open Four Post Metal Storage Shelving: Comply with MH 28.1; field assembled from factory formed components. Shelves span between supporting corner posts that allow shelf height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
  - 3. Load Carrying Capacity per Shelf: Minimum OR 400 lbs (182 kg).
  - 4. Posts: Fabricated from hot rolled steel; in standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf to post connectors.
    - a. Unit Configuration: Configure shelving units as individual, freestanding assemblies.
      - 1) Add On Shelf Posts: Fabricated from hot rolled steel, standard shape; perforated to match main posts.
    - b. Post Base: Adjustable steel floor plate, drilled for floor anchors.
  - 5. Bracing: Standard, single or double diagonal cross bracing.
    - a. Location: At unit back and ends necessary for stability, load carrying capacity of shelves, and number of shelves indicated.
    - b. Two sided sway braces and 1 back sway brace.
    - c. Back Panel: One piece fabricated from cold rolled steel sheet; of nominal: 0.024 inch (0.61 mm) steel sheet thickness.
  - 6. Solid Type Shelves:
    - a. Steel Sheet: Nominal thickness minimum 0.048 inch (1.21 mm) or as necessary for load carrying capacity per shelf.
    - b. Metallic Coated Steel Sheet: Nominal thickness minimum 0.052 inch (1.32 mm) or as necessary for load carrying capacity per shelf.
    - c. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars, angles, or channels.
  - 7. Framed Type Wire Shelves: Metallic coated steel] wire; with shelf frame fabricated from same material and with same finish as posts.

8. Truss Type Wire Shelves: Metallic coated steel wire over wire construction, with downturned wire truss edges.
9. Shelf Quantity: Six shelves per shelving unit in addition to top and bottom shelf.
10. Shelf to Post Connectors: Mechanical fasteners (nuts and bolts).
11. Base: Closed, with base strips fabricated from same material and with same finish as shelving.
12. Overall Unit Width: As indicated in the Drawings.
13. Overall Unit Depth: As indicated in the Drawings.
14. Overall Unit Height: 84 inches (2134 mm).
15. Accessories:
  - a. Finished End Panels: Fabricated as perforated full height panels from standard thickness cold rolled steel sheet and with same finish as posts, with trim for a finished appearance along edges abutting posts and top shelf.
16. Steel Finish: Baked enamel or powder coat.
  - a. Color and Gloss: Selected by Architect.

### **2.3 ANCHORS**

- A. Floor Anchors: Galvanized steel, post installed expansion anchors or power actuated fasteners. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.
- B. Wall Anchors: Galvanized steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

### **2.4 FABRICATION**

- A. Fabricate metal storage shelving components to provide field assembled units that are square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
  1. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
  2. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
  3. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.
- B. Form metal in maximum lengths to minimize joints. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing the work. Form backs of shelving units of up to 48 inches (1219 mm) wide from one piece.
- C. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch (0.8 mm). Shear and punch metals cleanly and accurately. Remove burrs.
- D. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so surface is smooth after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work. Examine floors for suitable conditions where metal storage shelving will be installed.
- B. Examine walls and ceilings to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.
- C. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 PREPARATION**

- A. Vacuum and clean finished floor over which metal storage shelving is to be installed.

### **3.3 INSTALLATION**

- A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
  - 1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  - 2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
  - 3. Adjust post base bolt leveler to achieve level and plumb installation.
  - 4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
  - 5. Install seismic restraints.
  - 6. Connect side to side and back to back shelving units together.
  - 7. Install shelves in each shelving unit at spacing indicated on Drawings.
    - a. Four Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

### **3.4 ERECTION TOLERANCES**

- A. Erect four post metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).
- B. Erect post and beam metal storage shelving to a maximum tolerance from vertical of 1/4 inch (6 mm) in 84 inches (2134 mm) of height.

### **3.5 ADJUSTING**

- A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.
- B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.
- C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

- D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 10 56 13**

## **SECTION 10 73 16.23 – METAL CANOPIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to
  1. Prefabricated aluminum covered walkways.
  2. Accessories necessary for a complete application.

#### **1.3 DELEGATED DESIGN**

- A. As scope and performance documents, the Drawings and Specifications do not indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Provide the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the aluminum walkway cover indicated, described, or implied.
- B. As a performance specification, the criteria for the solution of structurally sound aluminum walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the aluminum walkway cover is totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings for the aluminum walkway cover, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design, the decision of the Architect will take precedence.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. System Performance: Provide sunshade system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live loading, dead loading and wind loading in compliance with building code requirements for geographic area in which work is located and as follows:
  1. Live Load: 20 psf minimum.
  2. Structural design for wind forces: Comply with ANSI A58.1.
  3. Base Mean Wind Velocity: 144 mph, Exposure Classification C.
  4. Importance Factor: 1.0.
  5. Stability Criteria: Comply with applicable building codes.
  6. Design structural members to meet minimum deflection criteria of L/180.
  7. Design footings for maximum bearing pressure of 1,500 psf.

- B. Sizes shown on Drawings are considered minimum.
- C. Provide structure capable of sustaining severe icing, hail, hurricane force winds and supporting concentrated load.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

### **1.5 SUBMITTALS**

- A. Product Data: Technical data, specifications, component performance data, and installation instructions.
- B. Shop Drawings: Show sizes, locations and installation details including any internal drainage system details . Walkways canopy shop drawings shall include licensed Texas Structural Engineer's seal on submittal drawings.
- C. Samples: Color charts showing full range of colors.
- D. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Calculations: Provide signed and sealed structural calculations for the proposed walkway cover, by a professional engineer registered in the State of Texas and who professes his discipline to be structural engineering.
- F. Close-Out Submittals:
  - 1. Updated As-Built Drawings and Shop Drawings.
  - 2. Manufacturer contact names and addresses.
  - 3. Product and accessory model numbers and contact names/ address for future re-ordering of parts by Owner.

### **1.6 QUALIFICATIONS**

- A. Product shall be designed shop drawings prepared and sealed by Licensed Registered Texas Structural Professional Engineer.
- B. System shall be designed in accordance with FM Global I-90 wind uplift requirements and any other applicable building codes.
- C. System shall also be designed to comply with Underwriters Laboratories Class 'A' Fire Rating Requirements.

### **1.7 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Building Code: Applicable provisions of the International Building Code.
  - 2. AWS (American Welding Society) standards for structural aluminum welding.
- B. Product shall be designed, have shop drawings prepared and sealed by a Licensed Registered Texas Structural Professional Engineer.
- C. System shall be designed to comply with Underwriters Laboratories Class 'A' Fire Rating requirements.

- D. Installer Qualification: Firm with not less than 5 year documented experience in installation of aluminum sunshades of type, quantity and installation methods similar to work of this section.
- E. Source Limitations: Obtain aluminum covered walkway system from single source.

### **1.8 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store and handle sunshade system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

### **1.9 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of prior to preparation of shop drawings and fabrication. Allow for adjustments within specified tolerations wherever taking of field measurements before fabrication might delay work.

### **1.10 WARRANTY**

- A. Written warranty signed by manufacturer, Installer, and Contractor in which manufacturer agrees to repair or replace covered walkway assembly and its components that fail in materials or workmanship within specified warranty period.
  - 1. Defects shall include, but not be limited to:
    - a. Loose or missing parts.
    - b. Delamination or deterioration of finish.
    - c. Scratched, dented, and damaged surfaces.
  - 2. Warranty Period: One (1) year from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes does not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
  - 1. Warranty Period: One (1) year from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Basis of Design Manufacturer: AVAdek, Inc. Other manufacturers are subject to compliance with requirements:
  - 1. Aluminum Techniques
  - 2. American Walkway Covers, LLC.
  - 3. Childers Carports and Structures, Inc.
  - 4. Dittmer Architectural Aluminum.
  - 5. Mapes Industries, Inc.
  - 6. Peachtree Protective Covers, Inc.
  - 7. Perfection Protective Covers, Inc.
  - 8. Superior Metal Products Co.
- B. Aluminum Extrusion: ASTM B221 alloy 6063 heat treated to T-6 temper.
- C. Aluminum Sheet: ASTM B209, minimum 0.032 inch thickness.
- D. Finish: Clear Anodized.

- E. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.
- F. Beam/Deck connection flashing (Bird cover): .080" thick metal flashing at all beams. Provide bird protection devices at underside of all canopies. Typical locations will be where fluted roof decks cross over support beams.
- G. Fasteners:
  - 1. Deck Screws: Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8 inch (7 mm) outside dimension, conical washer. Rivets are not permitted.
  - 2. Fascia Rivets: Size 3/16 inch by 1/2 inch (4 mm by 13 mm) grip range aluminum rivets with aluminum mandrel.
  - 3. Bolts, Nuts, and Washers: 18-8 non-magnetic stainless steel.
  - 4. Tek Screws: Not permitted
- H. Miscellaneous Materials:
  - 1. Nonshrink, Nonmetallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.
  - 2. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Section 079200.
  - 3. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- I. Foundation and Footings: Design and construct foundations in accordance with governing codes and ordinances.
  - 1. Concrete: ACI 316, comply with requirements of Section 033000 or site mixed concrete consisting of 5 sacks of Portland cement complying with ASTM C150, per cubic yard of wet concrete combined with fine aggregate, clean water, and mixed in proportions to attain minimum 28 day compressive strength of not less than 3,000 psi.

## 2.2 FABRICATION

- A. Comply with indicated profiles, dimensioned requirements, and structural requirements. Provide minimum 6 inch by 10 inch (150 mm by 250 mm) structural bents. Provide fascia as indicated.
- B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.
- C. Mechanical Joints: Consisting of stainless steel bolts with minimum of 2 bolts per fastening. Install bolts and nuts concealed utilizing 1/2 inch thick by 1-1/2 inch (13 mm by 44 mm) aluminum bolt bars welded to structural members.
  - 1. Provide exposed rivets for fastening bottom of fascia to deck to match fascia finish.
  - 2. Provide concealed drainage from deck into columns.
- D. Flashing: 0.040 inch aluminum fabricated to prevent leakage of water between canopy and adjacent structures, where applicable.
- E. Provide concealed drainage from deck to columns.
- F. Roof Deck: Extruded 2 3/4 inch thick sections shall interlock in a homogenous structural unit, with joint designed and fabricated into a structurally rigid shape which is self flashing. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16 feet to offset dead load deflections. Use welded dams at nondraining ends of deck.



- G. Expansion Joints: Design structure for thermal expansion and contraction. Provide expansion joints as required with no metal to metal contact.
- H. Size horizontal U beams and vertical tube columns recommended by manufacturer for application and to comply with requirements.
  - 1. Attached with concealed fasteners.

### **2.3 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, [AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm] or thicker.
  - 1. Color: Clear.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions for compliance with requirements for supporting members, inserts, installation tolerances, and other conditions affecting performance of the work.
- B. Confirm locations, dimensions and elevations shown on shop drawings prior to fabrication.
- C. Proceed with installation after correcting unsatisfactory conditions.

### **3.2 PREPARATION**

- A. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

### **3.3 INSTALLATION**

- A. Set walkway support tube frames onto steel channels projecting from bidding structure; set to required elevations, align, plumb and level; secure tube frame to structural channels. Comply with manufacturer's instructions.
- B. Set roof support frames (bents) into pockets provided in top of footings; set to required elevations, align, plumb and level; and grout in place with portland cement grout. Ensure grout fills voids and keys to columns. Fill downspout units with grout to bottom of discharge level. Install aluminum deflectors after grouting. Match to finish and elevation of adjacent sidewalks.
  - 1. Provide column sleeves and set to elevations and dimensions on approved shop drawings.
  - 2. Install columns and beams straight and true.
- C. Install walkway deck sections, accessories, and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.
  - 1. Install raincaps over draining sections of the deck. Fill downspouts columns with grout to discharge level to prevent standing water. Install downspout deflectors after grouting.
- D. Flashings: Flashings required between covered walkway system and adjoining structures are not work of this section.

**3.4 CLEANING AND PROTECTION**

- A. Damaged Units: Replace roof deck panels and other components of the work that have been damaged or have deteriorated beyond successful minor repair.
- B. Cleaning: Remove protective coverings at time in project construction sequence that provide greatest protection of work. Clean finished surfaces to comply with recommendations of manufacturer.
- C. Protection: Protect completed work ensuring walkway cover will be without damage or deterioration at time of Substantial Completion.

**END OF SECTION 10 73 26**

## **SECTION 11 57 16 - PAINT SPRAY BOOTH - FLOOR STYLE**

CONDITIONS OF THE CONTRACT, SECTIONS AA THROUGH CB AND DIVISION 1 APPLY TO THIS SECTION.

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. Refer to Section AB – Instructions to Proposers, Section AF – Subcontractor / Manufacturer Prequalification, and Section 01 25 00 – Request for Substitution Procedures.

#### **1.2 SCOPE**

- A. Work Included: Include the following addition to items normally part of this Section:
  - B. 01 Design, fabrication and installation of paint spray booth.
  - 02 Design and installation of related ductwork, roof canopies and accessories.
- C. Work Specified Elsewhere:
  - 01 Division 7 - Roofing system.
  - 02 Division 21 – Fire Suppression
  - 03 Division 26 - Electrical
- D. Reference Standards: Spray booth construction and air flow velocities to conform to OSHA requirements.

#### **1.3 SUBMITTALS**

- A. Review and comply with all provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's literature, product data, certifications and supporting information for all products proposed to be furnished, as necessary to demonstrate compliance with the specified requirements.
- C. Shop Drawings: Submit complete Shop Drawings consisting of design, fabrication and erection / installation of proposed assemblies.
  - 01 Show profiles, sizes, spacing and locations of assembled components.
  - 02 Show details of shop fabrications, connections and details.
  - 03 Show details of field fabrications, connections and details.
  - 04 Indicate finish
  - 05 Indicate clearances, electrical connections, ducting and roof penetration details.
- D. Installation Instructions: Submit manufacturer's complete installation instructions, including fastening, for all products and / or assemblies proposed to be furnished.
  - 01 Installation details submitted for review shall be specific to the Work of this Contract and accurately depict interface within the assembly(s) indicated on the Drawings.
- E. Generic details that do not depict actual conditions shall not be acceptable. Maintenance Instructions: Submit manufacturer's complete operation and maintenance instructions and recommendations for all products and / or

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assemblies proposed to be furnished.

- 01 Include recommended cleaning products and instructions for use.
- 02 Where applicable, provide recommended maintenance schedules and procedures.

F. Operations and Maintenance Manuals:

- 01 Provide complete operations and maintenance manuals to the Owner.
- 02 Refer to Section 01 78 23 – Operation and Maintenance Manuals.
- 03 O & M manuals must be reviewed, accepted and delivered to the Owner prior to Owner demonstration(s).

G. Close-out Submittals:

- 01 Updated As-built drawings and shop drawings.
- 02 Product and accessory model numbers and contact names/addresses for future re-ordering of parts by Owner.

H. Supplementary Design Details: The general design shown is presumed adequate to permit compliance with the specified performance. Provide details to clarify and supplement the general design.

I. Certification: Submit manufacturer's certificate of compliance with OSHA requirements.

#### 1.4 DELIVERY AND STORAGE

- A. Delivery: Deliver clearly labeled, undamaged materials in the manufacturer's unopened containers or wrapping.
- B. Timing and Coordination: Deliver materials to allow for minimum storage time at the Project. Coordinate delivery with the scheduled time of installation, storage, and handling.
- C. Storage: Store materials in a clean, dry location, protected from abuse.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Approved Manufacturers: Specifications are based on the first named Manufacturer. Other manufacturers must meet or exceed this standard for approval.

- 1. RTT Engineered Solutions, Rockwell, TX (888) 452-75032 6684
- 2. Global Finishing Solutions, Osseo, WI 54758 (800) 848-8738
- 3. DeVilbiss Ransburg, Toledo, OH 43692 (800) 628-1200
- 4. Binks Manufacturing Co., Franklin Park, IL (708) 671-60131 3000

#### 2.2 MATERIALS

A. Paint Spray Booth:

- 01 Basis of Design: RTT Engineered Solutions, model IB-08-08-05-00-S
- 02 Size: 8'-4"W x 8'-2"H x 7'-8"L (exterior dimensions)
- 03 Cross-draft type, self-supporting unit constructed of 18-gauge galvanized

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- steel with filter intake doors and filtered exhaust plenum back panel.
- 04 Pre-finished 18-gauge galvanized steel frame and panels with the manufacturer's standard shop paint finish and 'white' strippable interior finish. Exhaust Fan:
- a. CFM: 8,000 SCFM @ 1/2" SP
  - b. Diameter: 24
  - c. Horsepower: 3
  - d. Voltage: 480
  - e. Phase: 3
  - f. Enclosure: TEFC
  - g. Quantity: 1
  - h. Provide exhaust duct system with fan rings, automatic dampers, clean-out doors, roof flanges, weather canopies with birdscreen, and required hardware as needed for complete installation.
  - i. Motor to be explosion proof
  - j. Provide air safety valve, interlocked with exhaust fan to prevent use of spray equipment when exhaust fan is off.
  - k. Motor shall have combination starter/disconnect switch at motor location. Timer function to be built into the VFD.
- 05 Lights:
- a. Type: LED
  - b. Voltage: 120/277 VAC
  - c. Phase: 1
  - d. Lumens: 8000
  - e. Quantity: 1
  - f. Provide switch for operator controls.
  - g. Fixtures to be serviceable from inside the booth and meet and fire/explosion ratings required for paint booth itself.
- 06 Accessories:
- a. Filters and filter racks for 2-inch thick filters in CFISD standard sizes: 16x20x2, 16x25x2; 20x20x2; and 20x25x2. No other sizes permitted.
  - b. Provide paint arrestor pads.
  - c. Visible gauge indicating rise in static pressure due to overflow residue accumulation.
  - d. Provide filter intake doors and filtered exhaust plenum.
  - e. Provide one (1) personnel access door at rear of booth (or other location in booth dependent on actual booth configuration per project design layout on drawings)
- 07 Prefinished frame and panels with the manufacturer's standard shop paint finish. 09 Spray booth construction and air flow velocities to conform to OSHA requirements.
- 10 Fire Suppression System: Provide fire sprinkler head(s) in booth, tied to building fire sprinkler system.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Obtain dimensions affecting the work of this Section from the site.
- B. Obtain electrical and mechanical service characteristics and rough-in location from site.
- C. No silicone-based sealants may be used in or around spray booth.

**3.2 INSTALLATION**

- A. Install the paint spray booth in strict accordance with the manufacturer's reviewed submittals and installation instructions.
- B. Install the paint spray booth in strict accordance with all governmental agencies having jurisdiction.
- C. Coordinate with electrical and mechanical contractors for proper interface.
- D. Upon completion of installation and testing, coordinate with Owner to provide complete training on the operation and maintenance of the paint spray booth.
  - 1. Training shall be conducted by a factory / manufacturer representative.

**END OF SECTION**

## **SECTION 11 61 33 – THEATRICAL RIGGING SYSTEMS AND STAGE DRAPERIES**

### **PART 1 - GENERAL**

#### **1.1 SECTION SUMMARY**

- A. This specification describes the installation of the theatrical rigging equipment and stage drapery tracks at the Arnold MS Stage.

#### **1.2 RELATED DOCUMENTS**

- A. Theatre Rigging Drawings (“TR” Series) and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

#### **1.3 SECTION INCLUDES**

- A. Coordination, provision, installation, inspection, commissioning, testing, documentation, instruction and warranties of Theatrical Rigging Systems.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and proper System.
- C. Also includes:
  - 1. Required licenses and permits including payment of charges and fees.
  - 2. Any required fees for testing, documenting, and notary public services.
  - 3. Verification of dimensions and conditions at the job site.
  - 4. Provision of required pre-installation submittals and project record manuals.
  - 5. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
  - 6. Extension of electrical service, including ground, to equipment locations.

#### **1.4 RELATED WORK**

- A. Section 11 61 62: Theatrical Lighting Systems.
- B. Division 26: Electrical Work.

#### **1.5 REFERENCES**

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
  - 1. American Iron and Steel Institute (AISI),
  - 2. American National Safety Institute (ANSI),
  - 3. American Society of Mechanical Engineers (ASME),
  - 4. American Society of Testing and Materials (ASTM),
  - 5. National Electrical Manufacturer’s Association (NEMA),
  - 6. Occupational Safety and Health Administration (OHSA),
  - 7. Underwriters Laboratories (UL),
  - 8. Entertainment Services and Technology Association (ESTA)
  - 9. Entertainment Technicians Certification Program (ETCP)

#### **1.6 DESCRIPTIONS AND REQUIREMENTS**

- A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the Theatrical Rigging Systems. Refer to the Theatre Rigging Systems (TR Series) drawings for further information relating to this Section.
- B. Cafeteria Stage
1. General:
    - a. The theatrical rigging system shall be comprised of overhead dead hung and motorized pipe battens for support of temporary theatrical lighting equipment, scenery, or stage draperies.
  2. The rigging components shall follow the requirements stipulated in this section and on the notes on the TR drawings.
  3. The rigging system is split between three general types of overhead batten:
    - a. Electric Battens:
      - 1) Electric battens shall be designed and installed to support lighting fixtures and associated wiring devices. Battens shall be dead-hung from overhead roof structure.
    - b. Motorized Fixed-Speed Lineset:
      - 1) Front-of-House (FOH) electric batten shall be designed and installed to support lighting fixtures and associated wiring devices.
      - 2) Batten shall be equipped with a motorized hoist mounted to the structure above the cafeteria as located on the drawings.
      - 3) Lighting battens shall be designed and installed to support lighting fixtures and associated wiring devices. A cable management system will provide electrical distribution to each lighting batten ensuring a permanent means of electrical connection to the lighting system.
      - 4) Hoists shall operate at a nominal 20 ft/min.
      - 5) A simple push-button controller shall be provided as located on the drawings.
    - c. Draperies and Curtain Tracks:
      - 1) Drapery tracks and hardware shall be provided and mounted to a dead-hung pipe batten to carry drapery as scheduled on the drawings.
      - 2) The traveler curtains, consisting of two (2) matched fabric panels, will part at center and draw open on a traveler track. The draw mechanism will be hand operated utilizing a sandbag weighted tension block for the operating line.
      - 3) The side masking shall be track mounted; operation will be by hand using walk-along track hardware.
      - 4) Drapery for the stage platform shall consist of a main curtain, masking legs and borders, a mid-stage traveler, and an upstage traveler as described on the drawings.
      - 5) Drapery and associated hardware shall mount on lineset battens as scheduled.
        - a) The main curtain, upstage traveler, and mid-stage traveler, each consisting of two (2) matched fabric panels, will part at their centers and draw open on a traveler track. The main curtain shall fully clear the proscenium when opened.
        - b) Borders/ Valance will tie directly to lineset battens.

C. General Requirements

1. Each rigging component must include the quantity of wire rope lift lines, trim chains, compression sleeve fittings, pipe or truss batten sections, and all necessary hardware for a fully operable rigging system.
2. Draperies shall be constructed of professional grade fabric intended for use as stage curtains. All draperies will be certified as flame retardant as a result of either their inherent characteristics or chemical treatment in accordance with the AHJ.
3. Adhere to and provide all needed repairs, inspections, and services as noted in the warranty portion of this specification.



## 1.7 RESPONSIBILITY AND RELATED WORK

- A. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making the field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. Coordinate the work with the General, Electrical and other related contractors as stated in Part 1.4, and the scheduled work of other trades.
- B. Conduit infrastructure system, including wire for AC Power and grounding for the Theatre Rigging Systems, shall be provided as part of the contract. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for Theatre Rigging Systems. The electrical installation shall be in accordance with division 26 and the National Electric Code.
- C. Verify the requirements and integrate components of the theatre lighting power and control system mounted to rigging hardware.
- D. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- E. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Theatrical Rigging Systems Installer to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires Theatrical Rigging Systems Installer to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- F. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.
- G. Execute all work in accordance with all Standard Authorities listed above, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

## 1.8 QUALITY ASSURANCE

- A. Theatrical Rigging Installer's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
  - 1. No less than five years' experience with equipment and systems of the specified types under the same business name.
  - 2. Experience with at least five projects of comparable scale within the last two years.
  - 3. Employ only fully trained stage riggers and mechanics for the erection of the stage equipment.
  - 4. All theatrical rigging activity shall be supervised by an ETCP certified theatre rigger.
  - 5. The stage riggers will be completely familiar with the type of equipment to be installed. A competent and knowledgeable Job Superintendent will be on the job at all times when work is in progress.
  - 6. Maintain a fully staffed and equipped service facility.
  - 7. Contractor shall attend pre-installation meetings to coordinate with other trades as required.

## 1.9 PRE-INSTALLATION SUBMITTALS:

- A. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the installer above 25% of the scheduled value of this work until all submittal information has been approved. Cost for the Owner's consultant to review secondary and re-submittals due to the Installer's failure to include all required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Installer. The cost shall be based on the hourly rates of the Architect and consultants as published in their current professional fees schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).
- B. Project Submittal Part 1:
1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
    - a. Section 1: A complete schedule of submittals.
    - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- C. Project Submittal Part 2:
1. Provide for approval no later than sixty (60) days after issuance of notice to proceed and in accordance with previously submitted submittal schedule.
    - a. Section 1: Complete list of products to be incorporated within the Work.
    - b. Section 2: Manufacturer's data sheets for each product. Provide original manufacturer's data sheets in order as they appear in the specification. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
    - c. Section 3: Fabric Samples. Submit a sample book of each fabric specified, containing manufacturer's standard colors available in the quality of fabric specified for the Owner's selection and approval of color. More than one color may be selected. After selection, upon request, submit one square foot sample of each fabric in each color for final review.
    - d. Section 4: Submit Material Safety Data Sheets (MSDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the MSDS.
  2. Drawings:
    - a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drawing (CAD) system compatible with AutoCAD release 2010. Electronic files of theatrical rigging contract documents shall not be distributed for use in generating submittal documents with the exception of architectural backgrounds.
    - b. Drawings depicting attachment of equipment to structure or mechanical assemblies that support overhead loads must show the work has been reviewed and sealed by a structural engineer licensed to practice in the State of Texas.
    - c. Installation Drawings. Provide drawings showing special details depicting methods and means specific to each product and each product manufacturer's recommended installation methods and means. Provide assembly and attachment for each product. Drawings should be reviewed and sealed by a structural engineer licensed to practice in the State of Texas.
    - d. Schematic Drawings. Provide drawings detailing inter-component and intra-component, on Theatrical Rigging Installer assembled components or fabricated products.
    - e. Conduit and Electrical Drawings. If the system incorporates an electrical or electronic system of any type, provide floor plan drawings, including all walls,

doors and rooms, showing exact power requirements and conduit routing for each system with the location of all junction boxes, terminations, etc.

- f. Equipment Drawings. Provide equipment mounting and location details including necessary physical dimensions, clearances, load limits, etc.
- g. Software diagrams showing the hierarchical structure of operator screens and functions with sample screen shots.
- h. Floor plan and Section Drawings. Provide drawings showing the exact location of all installed equipment on floor plans and/or sections such as guide wires or tracks, loft blocks, battens, etc.
- i. Custom Enclosures and Millwork Drawings. If custom enclosures or millwork is required, provide full fabrication detail drawings indicating size, material, finish and openings for equipment.
- j. Fabricated Plates, Panels, or Signage Drawings. If plates, panels, or signage is required, provide complete drawings depicting dimensioned locations of components, component types, engraving or printing information, plate material and color, and bill of material.
- k. Labeling Drawing. Provide representative equipment labeling scheme of locking rail, loading rail, etc.
- l. General Detail Drawings. Provide detail drawings depicting any unique installation methods specific to each product.
- m. Any other pertinent data generated which is necessary to provide the Work.

D. Submittal Format:

1. Electronic submission of submittals is encouraged. Where non- electronic submittals shall be bound in a three-ring D style binder sized for 150% of the material with a maximum size being a three inch spine. Use multiple volumes if necessary.
2. Provide each submittal with a unique number and be numbered in consecutive order.
3. Provide each submittal binder with a cover and a spine reflecting the project title and submittal number.
4. Provide each submittal with a complete table of contents with the following information:
  - a. Project title and number.
  - b. Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
  - c. Date of submission.
  - d. Referenced addendum or change-order number as applicable.
  - e. Referenced specification Section, Part, Article, Paragraph and page number or drawing reference as applicable.
  - f. Index Product Data sheets by manufacturer and model or part number.
5. Separate major grouping with labeled binder tabs.
6. Arrange product data list in alpha-numeric order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
7. Drawings executed at an appropriate scale, not smaller than  $\frac{1}{8}'' = 1'-0''$  for conduit/floor plans,  $\frac{1}{4}'' = 1'-0''$  for equipment layouts, and  $\frac{1}{2}'' = 1'-0''$  for mounting details and plate/panel details.

E. Submittal Copies:

1. These requirements represent minimum project requirements; a project's general conditions may require additional copies for project distribution.
2. Electronic submission of submittals is encouraged. Where non-electronic documents are required, submit all documents electronically in PDF format.
3. Where hardcopy submittals may be required,
  - a. Submit (3) bound prints of all drawings.

4. Submit (3) copies of bound materials (e.g. product data.)
  - a. Submit (2) sets of any product or sample finishes as required within this specification.
  
- F. Resubmission Requirements:
  1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
  2. Indicate any changes that have been made other than those requested.
  
- G. Approval of Submittals: The submittal information will be reviewed by the general contractor, owner, Architects, engineers, and consultant. Each submittal package will be returned, stamped as follows:
  1. "No Exceptions Taken" proceed with construction, all job site coordination will be at the direction of the general contractor.
  2. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
  3. "Make Corrections Noted: Submit Corrected Copy" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
  4. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  5. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
  6. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.

#### **1.10 PROJECT RECORD MANUAL**

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect's consultant; additional copies may be required by the project's general conditions) after substantial completion and prior to final inspection.
  
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
  1. Operations Manual:
    - a. Product Data: Product actually incorporated within the Work:
      - 1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer's serial numbers.
      - 2) Owner/Instruction Manual for each product.
      - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
      - 4) Manufacturer's wiring diagram for each type of product actually incorporated.
      - 5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
    - b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work. Provide one (1) full size set and one (1) DVD-ROM containing all CAD generated drawings prepared in conjunction with this project. Drawing files to be in AutoCAD Release 2010 DWG format.
    - c. Test Reports: Recorded findings of testing specification of this specification.
    - d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
      - 1) This procedure should describe the operation of all system capabilities.

- 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
  2. Service & Maintenance Manual:
    - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
    - b. Manufacturer's maintenance and care instructions.
    - c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
    - d. Replacement parts list of all minor equipment such as fuses, lamps, connectors, knobs, etc.
  3. Warranty Manual:
    - a. Manufacturer's warranty statements on each product.
    - b. Date of substantial completion and ending dates for warranties for each group of products.
    - c. Software registration and licenses.
- C. Include any other pertinent data generated during the Project or required for future service.
- D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

#### **1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with manufacturer's recommendation.
- C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.
- D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

#### **1.12 PROJECT CONDITIONS**

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

#### **1.13 FINAL INSPECTION AND TESTING**

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Architect and/or Architect's Consultant no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for inspection and two (2) persons for testing familiar with aspects of the System to assist the Owner.

- C. The process of testing the System may necessitate moving and adjusting certain components such as counterweights on arbors, adjustment of drapery tracks, etc.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
  - 1. Inspection of the methods and means employed to incorporate the System within the facility.
  - 2. Verification of proper operation, from controlling devices to controlled devices.
  - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each setting, and appropriately record these settings within the Record Documents.
  - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.
- G. Rigging system installer shall return to the jobsite six months after acceptance to inspect the rigging hardware and attachments, curtain tracks, curtains, and battens.

#### **1.14 WARRANTY**

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.
- D. This warranty will include two (2) ANSI-compliant annual inspections. The first will occur 1-year after the project's substantial completion, and the second shall occur before the end of the two (2) year warranty. The inspection will be a level one inspection for all manually operated systems for year one and a level two inspection for year two. Both inspections will be a level two inspection for all motorized equipment. The Contractor shall provide the inspections at no additional cost to the Owner and at an agreed-upon time and date. The Contractor shall provide a full report with deficiencies or findings to the Owner and WJHW. All repairs covered by applicable warranties will be completed.

#### **1.15 INSTRUCTION OF OWNER PERSONNEL**

- A. After final completion, provide instruction to Owner and/or the Owner's designated personnel on the use, operation, maintenance and care of the System.

1. Develop training course based on the use of the System and manufacturers' recommendation. Provide (8) hours of training. The training period shall be divided into two segments and shall be scheduled at least two weeks apart. All training shall be scheduled at the convenience of the owner and designated personnel.
2. Submit an outline of the course with sample instructional aids for approval (30) days prior to scheduled instruction sessions.
3. If a representative of the manufacturer is used in the instructional course, the Theatrical Rigging Systems Installer must be present throughout the extent of the course and ensure that the representative abides by the requirements set forth in these specifications.

B. Rigging system installer shall be present at the first two (2) uses of the facility.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Model name and number for manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
1. Proper substitution procedures outline under Division 1 is adhered to.
  2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
  3. Sufficient data of the products is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
  4. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.
- D. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

### **2.2 GENERAL**

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

### **2.3 CONTACTS**

- A. Listed below is contact information for Manufacturers of rigging components approved to provide equipment on this project. The below is not listed any preference or preferred order:
- B. Automatic Devices Company
1. 2121 S. 12th Street, Allentown, PA. 18103

2. Telephone: (610) 797-6000
  3. Approved to supply curtain track and curtain motors.
- C. Wenger (JR Clancy)
1. 7041 Interstate Island Road, Syracuse, NY 13209
  2. Telephone: (315) 451-3440
  3. Approved to supply stage rigging components, motorized hoists, hoist control, beam clamps, and associated hardware.
- D. Crosby Group, Inc.
1. P.O. Box 3128, Tulsa, Oklahoma 74101
  2. Telephone: (918) 834-4611
  3. Approved to supply rigging hardware including chain, cable clips, cable, and anchor shackles.
- E. Electronic Theatre Controls
1. 3031 Pleasant View Rd, PO Box 620979, Middleton WI 53562
  2. Telephone (608) 831-4116
  3. Approved to supply rigging hoists and controls.
- F. H&H Specialties
1. P.O. Box 9327, South El Monte, Calif. 91733
  2. Telephone: (213) 283-3562
  3. Approved to supply stage rigging hardware, curtain tracks, and curtain motors.
- G. K&M Fabrics
1. 2 Waco Street, Greenville, South Carolina 29611
  2. Telephone: (800) 845-1896
  3. Approved to supply curtain fabric.
- H. J.B. Martin
1. 445 rue St-Jean-sur-Richelieu, Quebec, Canada J3B 2M1
  2. Telephone: (514) 346-6853
  3. Approved to supply curtain fabric
- I. Rud Stage Rigging
1. 1300 Stoney Point Road SW, Cedar Rapids, Iowa 52408
  2. Telephone: (800) 553-7993
  3. Approved to supply rigging hardware including chain and shackles.
- J. Texas Scenic Company
1. 8053 Potranco Rd, San Antonio, Texas 78251
  2. Telephone: (210) 684-0091
  3. Approved to supply rigging Hoists and controls, rigging hardware, stage drapery
- K. Ver Sales, Inc.
1. 2509 N. Naomi Street, Burbank, Ca. 91504
  2. Telephone: (818) 567-3000
  3. Approved to provide rigging hardware including chain and beam clamps.
- L. IWeiss
1. 815 Fairview Avenue Suite 10, Fairview, New Jersey, 07022
  2. Telephone: (201) 402-6500
  3. Approved to supply rigging hardware, stage drapery, stage rigging hardware, and curtain tracks.



- M. Protech Theatrical Services
  - 1. 3431 N Bruce Street. North Las Vegas, Nevada 89030
  - 2. Telephone: (702) 639-0290
  - 3. Approved to stage drapery, stage rigging hardware, and curtain tracks.

## 2.4 RIGGING HARDWARE

- A. Batten Assemblies
  - 1. Pipe battens shall be constructed of new ASTM A53/A 1-½" nominal schedule 40 plain end steel pipe.
  - 2. Battens exceeding one standard pipe length will be joined using an internal splicing sleeve. Splices must provide the same overall capacity, deflection, and strength to the pipe battens as an un-spliced span. Threaded couplers are not permitted.
    - a. Splice sleeves shall be a minimum of 24" in length with a minimum of 12" extending into each pipe batten.
    - b. Sleeves will be machined to a diameter that will create a snug fit within the pipe battens.
    - c. Splicing sleeves will be fastened to the pipe batten with pins or ⅜-inch diameter bolts. Locate at least two fasteners on each side of splice joint; alternate direction of fasteners at right angles to one another across the diameter of the pipe.
  - 3. Any fasteners used on pipe battens must meet SAE grade 5 and be equipped with self-locking nuts.
  - 4. Cover the end of each batten with a yellow or white closed end, soft vinyl safety cap at least 4 inches in length.
- B. Batten Connections
  - 1. Wire rope lift lines shall terminate directly to trim chains constructed of NACM Grade chain, 1/4" or larger, and sufficiently long enough to wrap one and one-half times around the pipe batten and return to the eye of the wire rope lift line.
    - a. Chain must be rated for overhead lifting by its manufacturer.
    - b. Proof coil or other lesser grade chain than that approved are not permitted.
  - 2. The chain shall connect using a galvanized screw-pin anchor shackle rated for overhead lifting. Installed shackle pins shall be secured (moused) to prevent rotation.
  - 3. Alternative designs for batten connection and trimming methods shall require approval as part of the submittal process.
  - 4. Where a pipe clamp may be required on a batten, a wrap-around type clamp shall be provided. This clamp shall be secured to the pipe using SAE 5 grade bolts, washers, and self-locking nuts.
  - 5. Acceptable products:
    - a. JR Clancy Alpha Chain
    - b. 7 mm (0.275") Grade 63 alloy chain
- C. Wire Rope Lift Lines
  - 1. Provide lift lines and fittings appropriate for supporting the load requirements.
  - 2. For drapery, stage electrics, and utility linesets:
    - a. Lift lines shall be a minimum of 3/16" diameter 7 X 19 construction, galvanized aircraft cable with a breaking strength of 4200 lbs.
  - 3. For the FOH self-climbing hoist truss:
    - a. Lift lines shall be a minimum of 1/4" diameter 7 X 19 construction, galvanized aircraft cable with a breaking strength of 7000 lbs.
  - 4. All wire rope must be new; damaged or deformed cable may not be used.
  - 5. Exposed ends of wire rope shall be cut cleanly, then seized as necessary.
- D. Wire Rope Terminations
  - 1. To connecting hardware: form eyes around an appropriately sized thimble using copper Nicopress® compression sleeves.
  - 2. To cable drums: terminate the wire rope on the inside of the lifting drum using a Nicopress® compression stop sleeve.

3. Supply and install compression sleeves or clips in size and quantity per guidelines set forth in the Wire Rope User's Manual, by its manufacturer's specifications, and in accordance with industry guidelines.
- E. Rigging Accessories:
1. In certain instances special component parts, such as sheaves, idler blocks, extra lines, etc., will be necessary in order to provide a fully operable system. Where such requirements are necessary, furnish, install, and adjust these components comparable to the quality of the products listed in these specifications.
  2. Acceptable manufacturers:
    - a. H&H Specialties
    - b. Crosby
    - c. ETC
    - d. Thorn Stage Equipment

## 2.5 LINESET HOIST CONFIGURATIONS

- A. Motorized lighting linesets – FOH Electric
1. Install new linesets equipped with fixed speed motorized hoists over the stage platform as located on the drawings. Each lineset will consist of a double batten with wire rope lift lines in quantity and location as specified on the drawings.
  2. All hoisting elements shall mount to an integrated aluminum extrusion backbone.
    - a. Backbone shall be sized appropriately to the noted loads
    - b. Hardware shall be provided to secure backbone to existing building structure. Provide supplemental strut as needed to bridge existing structure.
  3. The lineset assembly shall include the mounting of lighting power distribution and control components as specified on the drawings and provided by theater lighting contractor.
  4. The hoisting system and its components shall be sized to the load capacities as specified on the drawings.
  5. Provide a motorized hoist for each of the lighting battens as located and described in the drawings.
  6. The hoist shall lift the batten at a nominal rate of 30 ft/min.
  7. The electronic drive supplying the hoist motor must allow field adjustable acceleration and deceleration rates in order to minimize the effects of dynamic or shock loading on the system.
  8. Lighting Equipment Integration
    - a. The load circuits and control wiring shall be fed to the batten by a cable reel system or integral ribbon style cable management system
    - b. Size cable reel for the travel and necessary conductors as shown in the TL documents.
    - c. Acceptable product:
      - 1) Prodigy Cable Management System
      - 2) Conductix
      - 3) Or approved equal
  9. Acceptable product(s)
    - a. ETC Prodigy P800E
    - b. JR Clancy Varion
    - c. Approved equal

## 2.6 HOIST CONTROL

- A. The control system shall be specifically designed for use with the hoists installed with the system. The control system shall provide easily understandable and reliable position control of hoists. All hoists shall be controlled from a single Rigging Control Panel (RCP)

- B. The control system shall be purpose-designed and fabricated to manage and operate hoists specifically designed for overhead lifting. The systems shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment and shall provide an engineered, efficient device to control the equipment.
- C. The following features shall be included:
1. RCP shall consist of a surface, flush or panel mounted primary control panel and up to three external remote E-stop stations.
  2. Key operated enable switch
  3. LCD display with feedback/operating information
  4. Key operated hoist load profile training/enable switch
  5. Hoist selection buttons with rear illuminated naming tabs
  6. Rear illuminated hold-to-operate (dead-man) up and down operation buttons
  7. Dedicated E-stop button
  8. Outlet for wired remote
  9. The controller shall be UL Listed and shall be fabricated from UL Listed components.
  10. A single Cat 5e cable shall provide the power and communication wiring between the power and control wiring devices and the RCP.
- D. Power and Control Wiring
1. Provide purpose-built wiring devices to distribute hoist power and control as described on the drawings.
  2. Each hoist shall receive power and control via a pair of 8'-0" long jumper cables extending from the hoist power-head to source outlets on the wiring device.
  3. The receptacles shall be installed in a sheet metal junction box located less than 8'-0" away from each hoist power-head and shall include a power and control outlet.
  4. Provide a 20A 3-phase breaker in the distribution box for each hoist.
  5. The wiring and connectors shall be barriered between high and low voltage.
  6. The power/distribution channel shall be UL listed for this application.
- E. System Diagnostics
1. Upon energization, the control system automatically shall perform a series of diagnostic tests that shall assure that all system safety functions are working. Should an error in the safety functions be determined the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault.
  2. Should the controller be continuously energized, the system automatically shall perform a series of diagnostic tests every 30 days to determine if there are any problems with any portion of the hoisting control system safety features. In the event of a problem, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault.
  3. The automatic self-tests shall include a complete test of all Emergency Stop contactors for their respective ability to reach the off state.
  4. Eleven months after a system inspection has been performed, the system will remind the user to schedule full system maintenance/inspection. The reminder will remain in the system until it is turned off by the factory authorized and trained inspector.
  5. The system inspection reminder shall show the number of days remaining until the system inspection, or the number of days the inspection is overdue.
- F. Remote Control Pendant
1. A remote-control pendant with a 30'-0" long attached cable and plug shall be provided for the system. The remote control must be plugged to the RCP. When the remote control is plugged in the E-stop on the remote is active.
  2. The remote control provides up/down control for those hoists that have been preselected at the RCP.

- G. Acceptable product(s)
  - 1. ETC QuickTouch+ Controller with pendant control station accessory.
  - 2. JR Clancy SceneControl
  - 3. Approved equal.

## 2.7 FIXED LIGHTING PIPES

- A. Provide and install pipe assemblies attached to side walls as described in the drawings.
- B. Assemblies shall be constructed of new ASTM A53/A 1-½" nominal schedule 40 plain end steel pipes.
- C. Any fasteners used on pipe battens must meet SAE grade 5 and be equipped with self-locking nuts.

## 2.8 CURTAIN TRACKS

- A. Straight Draw Curtain Tracks
  - 1. Provide and install the curtain tracks as located and configured on the drawings.
  - 2. Track shall be constructed of 14 gauge galvanized steel, roll formed to a 2-5/8" W X 2-3/4" channel with continuous slot in bottom. Provide un-spliced lengths up to 26' in length.
  - 3. Track must mount to pipe battens on maximum 5'-0" centers with two-piece hangers formed from 11 gauge steel.
  - 4. Provide a minimum of 2'-0" overlap in the center. Separate tracks at center with two overlap clamps.
  - 5. Install carrier stops with at each end of track.
  - 6. Provide single carriers, spaced 12" on center, constructed of (2) nylon-tired ball bearing wheels fastened parallel to carrier body. Supply carriers with heavy duty hook, swivel eye, and trim chain for attachment of drapes. Install neoprene bumper between each carrier to reduce noise.
  - 7. Provide master carriers with 4-wheel nylon-tired ball bearing assemblies with bodies formed from 11 gauge steel. Connect to operating line with two formed steel cord clamps attached to each body. Supply each master carrier with two heavy duty hooks, swivel eyes, and trim chains for attachment of leading edge of drape.
  - 8. Single and double end pulleys will clamp securely to the underside of the track channel and will be equipped with 6" diameter Nylatron GS sheaves grooved for up to ½" hand line. Install (2) 5/8" sealed precision ball bearings in each sheave. Lock shaft to side plate on head end with 3/16" keeper pin to prevent rotation and install fine threaded nylon insert lock nut.
  - 9. Dead end pulley shall be mounted at 45 degrees from the traveler tracks to reduce clearance required for pulley between pipe battens.
  - 10. Provide a sand bag tension pulley for operation of hand line of the mid-stage traveler. Provide adequate quantity of sand for proper hand line operation.
  - 11. Hand line shall be 1/2" diameter, stretch resistant rope with spun polyester outer jacket double braided over solid polyester core.
  - 12. Acceptable products:
    - a. H&H Specialties series 400
    - b. ADC series 280
- B. Walk-along Curtain Tracks
  - 1. Provide materials and the labor to install the curtain tracks as located and configured on the drawings.
  - 2. Track shall be made of 6063-T5 aluminum, extruded into 2-½" I-beam with 1" wide top, intermediate and bottom flanges. Provide un-spliced lengths up to 24' in length.
  - 3. Track must mount to pipe battens on maximum 5'-0" centers with two-piece hangers formed from 11 gauge steel hangers.
  - 4. Provide single carriers, spaced 12" on center, constructed of (2) Delrin wheels fastened parallel to formed steel carrier body. Supply carriers with swivel hook for attachment of

drapes. Install Nylatron wear strips at contact points to act as a bumper between each carrier to reduce friction. Provide neoprene bumpers between each carrier to reduce noise.

5. Provide walk along handles attached to the master carriers for operation of the curtain.
6. Provide end stops at each end of the track.
7. Ensure that all steel components are zinc plated for corrosion resistance.
8. Provide all track and associated hardware factory coated BLACK
9. Acceptable products:
  - a. H&H Specialties series 300
  - b. ADC series 140

## 2.9 STAGE DRAPERY

### A. General Specification for Stage Drapery

1. Provide and install all curtains as located and scheduled on the drawings.
2. Field verify all dimensions prior to fabrication of draperies.
3. Curtain fabric of professional grade fabric intended for stage use. If not inherently flame retardant, curtain fabric shall be chemically flame proofed at the mill using an immersion process. Flame proofing certificates for all fabrics used shall be furnished to the owner with the as-built drawings.
4. Sew tags identifying manufacturer and size of panel at each end of webbing at top and at one corner at hem in each drape.
5. Curtains must be constructed with vertical seams unless otherwise specified. The fabric grain shall run nap down and match in all panels. All panels must be un-spliced along their height.
6. Construction
  - a. Black Poly webbing at 3" wide shall be double stitched to the top of the curtain with 1" of face fabric turned under the webbing.
  - b. Brass rustproof grommets shall be inserted
    - 1) at the extreme top corners
    - 2) in the pleat centers of curtains sewn with fullness, or
    - 3) on 12" centers for flat curtains.
  - c. Grommet holes for track mounted curtains shall be supplied with
    - 1) plated wire "S" hooks, or
    - 2) snap hooks, sewn-in at the spacing noted above.
  - d. Drapery hung directly from an auxiliary batten shall have a 24" long black cotton tie line fastened in each grommet hole.
  - e. The centerline of the drape shall be marked on the top webbing with "CL" and a white tie line added to the corresponding grommet.
  - f. Curtains sewn with fullness shall have box pleats spaced 12" on center.
  - g. Bottom hems shall be 4" wide. These shall be sewn with a separate canvas chain pocket inside so that the bottom of the canvas pocket rides 2 inches above bottom of the hem. Provide #8 plated jack chain in the pocket.
  - h. All traveling curtains shall be sewn with a minimum 24" of face fabric turned back at the leading edge. All other vertical hems shall be 2".
7. Use mercerized cotton thread, minimum weight of #16, color to match drape fabric.
8. Sew a 12" x 12" swatch of fabric near the lower offstage corner of each drapery for fire-residence testing by the AHJ.
9. Fabric colors shall be as scheduled. Submit color sample card with submittal documents. Make all effort to ensure that curtains of the same color are fabricated from fabrics of the same dye lot.
10. Labeling
  - a. Sew labels onto the back (in most cases, upstage) side of the upper hem at both ends of each panel.

- b. Curtain must have NFPA 701 flameproof certification tag sewn on the bottom of each curtain panel for Fire Inspection reference. This label should have permanent stitching around all four sides.
  - c. Labels shall clearly indicate
    - 1) date of manufacture
    - 2) cloth type
    - 3) manufacturer's name and address
    - 4) size (width and height using 3/4" minimum lettering)
    - 5) owner's designated inventory number
11. Acceptable product:
- a. For nominal 24-25 ounce fabric
    - 1) KM Fabrics Charisma inherently flameproof velour.
  - b. For nominal 20-21 ounce fabric
    - 1) KM Fabrics Crescent inherently flameproof velour.

## 2.10 COMPLETED SYSTEM

- A. General
- 1. All installation of stage rigging equipment shall be completed utilizing new materials, free from flaws and rust, and in good working order. The jobsite shall be cleaned of all packing materials, lubricants, metal shaving, miscellaneous hardware, and components not used in the installation.
  - 2. All dimensions are to be field verified. Location and attachment of hardware and size of components shall be confirmed by the stage rigging installer.
  - 3. All electrical power, outlets, related systems, and structural elements required to make the system fully functional are the responsibility of the contractor.
  - 4. If components and hardware are not specifically specified or called out, it is the responsibility of the contractor to provide those components in order to provide a fully operational theatre rigging system.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place in accordance with specified safety factors and Federal and State codes and regulations.
- D. Work shall be completed within industry guidelines, including, Entertainment Services and Technology Association (ESTA), OSHA, National Electric Code, American National Standards Institute, American Society for Testing and Materials, American Institute of Steel Construction, National Fire Protection Association, National Electrical Manufacturers Association, plus any or all local, governmental, or other applicable codes.
- E. Where dimensions and loading capacities have been omitted from this specification, they are to be determined by the Contractor, in accordance with the accepted industry standards and guidelines in this section. In no way will the theatre rigging contractor be relieved of primary responsibility to provide a safe, fully functional system.

- F. The mechanical fabrication and workmanship will incorporate the best practices for good fit and finish. There will not be any burrs or sharp edges to cause a hazard, nor will there be any sharp corners accessible to personnel.
- G. All equipment will be installed based on the manufacturer's recommendations and for the use intended by the manufacturer.
- H. All shop and field welding will meet the qualifications of the AISC manual and will be without spatter or other evidence of poor practices.
- I. All finishes which are disturbed during shipping and installation will be touched up to match the original.
- J. Materials will conform to the following ASTM standard specifications:
  - 1. A-36 structural steel
  - 2. A-36 steel plates and bars
  - 3. A-47 malleable iron casting
  - 4. A-48 gray iron casting
  - 5. A-53 welded and seamless steel pipe
  - 6. A-120 black and hot dipped zinc-coated steel pipe
- K. In order to establish minimum standards of safety, the following factors will be used:
  - 1. cables and fittings provide a minimum 8:1 design factor
  - 2. cable bending ratio is 30 times the cable diameter
  - 3. nuts and bolts use minimum SAE grade 5 (ASTM rating A-449)
  - 4. thread pressure of
    - a. 500 lb. for cast iron
    - b. 1000 lb. for steel
    - c. 1500 lb. for Nylatron
  - 5. steel designed to 1/5 of yield
  - 6. bearings are rated for two times the required load operating at full speed for 2000 hours.

### **3.2 INSTALLATION OF MOTORIZED RIGGING SYSTEM**

- A. All wire rope components will be installed so as to prevent abrasion or rubbing of the wire rope against any part of the building construction or other equipment.
- B. Pulleys and sheaves will be aligned as to provide a maximum fleet angle of 1.5 degrees. Mule blocks, cable rollers, guides, and sag bars will be installed as required to provide proper alignment.

### **3.3 INSTALLATION OF STAGE DRAPES AND TRACKS**

- A. Install all tracks and hardware according to manufacturer's recommendations.
- B. Stage draperies shall be installed near the end of the installation when chances of damage from other work are reduced. Stage area shall be broom clean with no further construction taking place prior to installation.
- C. After hanging stage draperies, thoroughly brush to remove dust, visible dirt, loose threads, loose fabric lint, etc. Wrinkles will be allowed to fall out naturally.

### **3.4 LABELING OF EQUIPMENT**

- A. Mark and label each batten with its set number, load/arbor capacity, stage centerline, and lift line locations with appropriate paint.
- B. Provide labels clearly indicating date of manufacture, cloth type, manufacturer's name and address, size (width and height using 3/4" minimum lettering), and Owner's designated inventory number (to be coordinated with Owner) will be sewn into the back (in most cases, upstage) side of the upper hem at both ends of each drape panel.

### **3.5 CONTRACTOR COMMISSIONING**

- A. Prior to energizing or testing the System ensure the following:
  - 1. Products are installed in proper and safe manner according to manufacturer's instructions.
  - 2. Dusts, debris, solder splatter, etc. is removed.
  - 3. Labeling has been provided.
  - 4. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
  - 5. Products are neat, clean and unmarred and parts securely attached.
  - 6. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. Job site shall be left broom clean.
- B. Provide two portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project.
  - 1. Include rechargeable batteries and re-charger along with "holster" for wearing on belt.
  - 2. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

**END OF SECTION 11 61 33**



## **SECTION 11 61 62 - THEATRICAL LIGHTING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Provision of the Theatrical Lighting Systems at the Cafetorium Platform.

#### **1.2 RELATED DOCUMENTS**

- A. Theatre Lighting Systems Drawings ("TL" Series) and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.
- B. Section 11 61 33: Theatrical Rigging Systems, drawings, and documentation.
- C. Section 27 41 16: Audio Video Systems and Equipment, drawings, and documentation.
- D. Division 26: Electrical Work drawings and documentation.

#### **1.3 SECTION INCLUDES**

- A. Project instructions for the Contractor and System description details.
- B. System product descriptions.
- C. Project completion instructions for the Contractor.

#### **1.4 RESPONSIBILITY AND RELATED WORK**

- A. Coordination, supply, installation, shipping, storage, inspection, commissioning, testing, instruction and warranties of the Theatrical Lighting Systems.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and fully functioning System.
- C. Also includes:
  - 1. Required licenses and permits including payment of charges and fees.
  - 2. Verification of dimensions and conditions at the job site.
  - 3. Provision of submissions.
  - 4. Installation in accordance with the Contract Documents, Manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
  - 5. Extension of electrical service, including ground, to equipment locations.
- D. The drawings included with this specification convey general system concepts. Where the plans do not show complete and accurate building details, the Contractor is responsible for making field measurements necessary to establish exact locations, relationships, and load capacities necessary for the installation of these systems.
- E. Coordinate the work with the related documents and the scheduled work of other trades.
- F. Conduit infrastructure system, including wire for AC Power and grounding for the Theatrical Lighting Systems, are provided as part of the Contract. Coordination between different

disciplines is required to achieve a proper conduit system installation and power provisions for Theatrical Lighting Systems.

- G. Supply accessories and minor equipment items needed for a complete and fully operational system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- H. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires the Contractor to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- I. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Architect for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of their failure to have brought said discrepancies to the attention of the Architect.
- J. Execute all work in accordance with the NEC and all applicable State and Local codes, ordinances, and regulations.
- K. If a conflict develops between the Contract Documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

## 1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
  - 1. American National Standards Institute (ANSI)
  - 2. American Society of Testing and Materials (ASTM)
  - 3. Electronics Industries Association (EIA)
  - 4. Institute of Electrical and Electronic Engineers (IEEE)
  - 5. National Electrical Manufacturer's Association (NEMA)
  - 6. National Electrical Code (NEC)
  - 7. National Fire Protection Association (NFPA)
  - 8. Underwriters Laboratories (UL)
  - 9. Occupational Safety and Health Administration (OSHA)
  - 10. Entertainment Services and Technology Association (ESTA)
  - 11. United States Institute of Theater Technology (USITT)
  - 12. Illuminating Engineering Society (IES)

## 1.6 DEFINITIONS

- A. In addition to Division 1 definitions, the following list of terms as used in this Section shall be defined as:
  - 1. Owner – Cypress-Fairbanks Independent School District
  - 2. Project – Arnold Middle School
  - 3. Consultant(s) – The Owner's Technical Representative(s) for this Section
  - 4. Architect – PBK
  - 5. Contractor – The provider of all material, labor, and equipment necessary for the systems described in this Section.
  - 6. Furnish/Supply – To purchase, procure, acquire, and deliver complete with all necessary accessories (CWANA)

7. Install – To set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, item, or equipment supplied by the contractor.
8. Provide – To furnish and install

## 1.7 DESCRIPTIONS AND REQUIREMENTS

- A. Lighting and Control System – Cafetorium
  1. The new Cafetorium lighting system shall be comprised of a DMX/eDMX control system communicating with the distributed power system and DMX/eDMX devices to control all lighting elements within the performance space.
  2. The lighting control console shall be located at the back-of-house or at the stage. Console shall operate directly over the lighting control network.
  3. The motorized breaker panel shall be located at the stage.
  4. The motorized breaker panel and the control distribution panel (CDP) shall be located at the platform. The control distribution panel will contain all network and DMX interface control components.
  5. Switched power shall be distributed throughout the Cafetorium in recessed wall mounted, pipe mounted, batten mounted, and structure mounted devices.
  6. Network and DMX control shall be distributed throughout the Cafetorium through a series of plug in ports.
  7. Architectural Lighting system shall be capable of supporting the same DMX values as the control console so that looks may be snapshotted then recalled through architectural station presets. This will include control of switched theatrical lighting circuits and DMX-controlled performance fixtures.
  8. Provide a master touch screen architectural lighting control station as indicated on the drawing.
  9. Provide theatrical lighting fixtures and required accessories. Installation is required under this base specification.
- B. Fixture Focus
  1. Contractor will hang, focus, and program lights to an Owner directed plot.
  2. The Owner may elect to generate their own plot. If not, the Consultant will provide this documentation.
  3. If the Contractor finds any needed updates or changes before hang begins the Consultant or Owner will update the documents as needed.
  4. The Contractor is responsible for tracking and updating all changes to the plot after it has been turned over for installation. These updates and changes may be provided to the Consultant as necessary. However, the Contractor is responsible for these updates and may be provided the plot in an editable format to make the updates.
  5. The Consultant produced plot will provide the following information if applicable for each fixture:
    - a. Location
    - b. Unit number for that location
    - c. Type
    - d. Area/purpose
    - e. Mode
    - f. Fixture universe/address
  6. As part of turnover documents, the Contractor will be required to ensure the following are provided:
    - a. An electronic version of the plot. Provided on a flash drive and preserved by the Contractor for at least the length of the warranty.
    - b. A B-sized version of the plot mounted to foam core-like material.
    - c. All of the information listed above in number 5 and additionally all circuiting of fixtures.
  7. As part of the final observation and testing (3.5) Consultant will verify the focus.

C. Console Programming

1. The Contractor shall create a starting show file for the project. The file will be loaded onto the console, provided to the Owner on a flash drive, and preserved by the Contractor for at least the length of the warranty. The Contractor will provide the starting show file to the Owner, if requested, following the requirements laid out in the warranty portion (1.14) of this specification and shall be considered a service call.
2. Owner may select to add, update, or change any of the information below. These changes may be directed before, during, or after initial training. The Contractor will make any requested changes provided any amount of training time is left in the project as outlined in the instruction of Owner personnel of this specification (3.6).
3. At the Owner's request program any fixture, color, or controllable attribute to provided faders.
4. Ensure all areas outlined in the console programming portion of this specification are covered as part of the instruction of Owner personnel of this specification (3.6).
5. Using the provided plot, the Contractor shall create the following console programming at a minimum, if applicable:
  - a. Patching
  - b. Patch all fixtures to channel numbers outlined in the plot.
6. Groups
  - a. (1) group for every area of the plot.
  - b. (1) group for every "row" of front lights
  - c. (1) group for every "row" of front lights from the left
  - d. (1) group for every "row" of front lights from the right
  - e. (1) group for every "row" of top lights
  - f. (1) group for every "row" of backlights
7. Palettes
  - a. Intensity
    - 1) Provide a 70% intensity for use in creating cues.
  - b. Color
    - 1) Provide warm (R02) and cool (R3202 or R60) for ease of selection.
    - 2) A warm white. Roughly 3200K
8. Interactive Control Display (Magic Sheet)
  - a. Provide an interactive control display to aid in programming and console use
  - b. The interactive display shall utilize a combination of standard and user-defined symbols to generate a fixture layout which copies the light plot as closely as reasonably possible.
  - c. Selectable fixtures will, at a minimum, indicate the following parameters or palettes and their current states:
    - 1) Fixture type
    - 2) Channel
    - 3) Intensity
    - 4) Color
  - d. Provide controls for all groups as described above.

**1.8 QUALITY ASSURANCE**

- A. Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
1. No less than five (5) years of experience with equipment and systems of the specified types.
  2. Experience with at least five (5) comparable scale projects within the last two (2) years.
  3. Engage the services of a Manufacturer certified technician.
  4. Be a franchised dealer and service facility for the manufacturer's products furnished.
  5. Maintain a fully staffed and equipped service facility.
  6. At the request of the Architect, demonstrate that:
    - a. Adequate plant and equipment are available to complete the work.

- b. Adequate staff with commensurate technical experience is available.
- B. Manufacturer's Qualifications:
- 1. No less than five (5) years continuous experience in the production of specified type of product.
  - 2. Production shall meet applicable NEMA standards.

### 1.9 SUBMITTALS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures section unless otherwise indicated.
- B. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the Contractor above 25% of the scheduled value of this work until all submittal information has been approved.
- C. Submittals must be original work produced by the firm responsible for performing the work defined in this specification. Scanning, photographic copying, materially copying, or any other reproducing the contents of the drawings or specifications contained within the Contract Documents will be marked as unacceptable and not reviewed for any content. No claim shall be made for delay, undue burden, or additional costs for the effort to produce shop drawings, schedules, and equipment lists addressing this specification or the overall project manual.
- D. Project Submittal Part 1:
- 1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
    - a. Section 1: A complete schedule of submittals.
    - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- E. Project Submittal Part 2:
- 1. Provide for approval no later than sixty (60) days after issuance of Notice to Proceed and in accordance with previously submitted submittal schedule.
  - 2. Products:
    - a. Section 1: Complete list of products to be incorporated within the Work (Bill of Materials).
    - b. Section 2: Manufacturer's data sheets for each product.
      - 1) Provide original manufacturer's data sheets in order as they appear in the specification.
      - 2) Data sheets are required for each product in sufficient detail to evaluate product suitability for incorporation within the Work.
      - 3) Product literature shall include documentation of UL Listing or approved recognition by a Nationally Recognized Testing Laboratory (NRTL).
    - c. Section 3: Provide Architect and/or Architect's Consultant with samples of wall plate materials and colors as specified in this section.
    - d. Section 4: Submit Safety Data Sheets (SDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the SDS.
  - 3. Drawings:
    - a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system. Electronic files of theatrical lighting contract documents shall not be distributed for use in generating submittal documents with the exception of Architectural backgrounds.
    - b. Schematic Drawings.

- 1) Provide drawings detailing cabling-riser intent.
  - 2) Give each component a unique designator and use this designator consistently throughout the project.
  - 3) Include inter- and intra-component connections and cabling diagram depicting cable types, designators, and color codes.
  - c. Installation Drawings.
    - 1) Provide drawings showing the coordinated locations of all installed equipment. Drawings shall include floorplans and other views as necessary to fully describe the intended finished conditions.
    - 2) Provide Conduit and Electrical Drawings indicating:
      - a) Conduit sizing/routing for each system component,
      - b) Locations where power is required along with the location of all junction boxes.
    - 3) Detail Drawings: Provide drawings showing special details depicting methods and means specific to each product, assembly and each product Manufacturer's recommended installation methods and means.
  - d. Equipment Drawings:
    - 1) Rack and Panel Elevations: Provide a front elevation of all racks and/or panels.
    - 2) Rack and Panel Assembly Details: Provide drawings showing location of equipment in racks with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
    - 3) Custom Enclosures and Millwork Drawings: Provide full fabrication detail drawings indicating size, material, finish, and openings for equipment.
    - 4) Fabricated Plates and Panels Drawings: Provide complete drawings of custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
  - e. Schedule Drawings: Provide load schedules noting source and destination of wiring and associated connected load.
  - f. Labeling Drawing: Provide representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.
  - g. General Detail Drawings: Provide detail drawings depicting any unique installation methods specific to each product.
  - h. Control Screen Templates: Provide layout drawings and/or screenshots for master house lighting stations and similar electronic control surfaces.
4. Any other pertinent data generated which is necessary to provide the Work.
- F. Submittal Format:
1. Electronic (PDF) submittal documents are required for review.
  2. Provide each submittal with a unique number and each shall be numbered in consecutive order.
  3. Submittals shall not be issued with other disciplines.
  4. Provide each submittal with a complete table of contents with the following information:
    - a. Project Name
    - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and shall be numbered in consecutive order.
    - c. Date of submission.
    - d. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable.
  5. Follow list by Manufacturer's data sheets, arranged as in Part 2 of this specification. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
  6. Drawings executed at an appropriate scale, but not smaller than 1/8" = 1'-0".

- G. Resubmission Requirements:
1. Make any requested corrections or change in submittals required. Resubmit for review as directed.
  2. Indicate any changes that have been made other than those requested.
  3. Approval of Submittals: Each submittal package will be returned with one of the following stamps:
    - a. "No Exceptions Taken" proceed with construction; all job site coordination will be at the direction of the General Contractor.
    - b. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
    - c. "Make Corrections Noted: Submit Only Corrected Pages/Items" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
    - d. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
    - e. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
    - f. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.
  4. Any of the above stamps may also carry a "PARTIAL" stamp. This indicates that required information noted in the section above was not provided. Omitted items may be noted as part of the reviewed submittal, but it is the Contractor's responsibility to verify all required submittal documentation.

#### 1.10 PROJECT RECORD MANUAL

- A. Provide electronic copies of the project record documents or as required per the General Conditions of the Project.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
1. As-Built Record Documents:
    - a. Product Data:
      - 1) List of all products incorporated in the Project inclusive of all substitutions, field changes, or revisions The list shall include Manufacturer's serial numbers.
      - 2) Manufacturer's data for each type of product conforming to the scheme above.
      - 3) Organize and bind the above in specification order.
    - b. Record drawings: Final rendition of project drawings enumerated in the Submittal section above. Provide editable computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system, in both a DWG and PDF file format.
    - c. Test Reports: Record findings of systems testing described in Part 3 below.
  2. Operations Manual
    - a. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
      - 1) This procedure should describe the operation of all system capabilities.
      - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
  3. Service & Maintenance Manual:
    - a. Provide an original copy of the service manual on every piece of equipment for which the Manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.

- b. Manufacturer's maintenance and care instructions.
- c. Maintenance Instructions: include maintenance phone number(s) and hours, maintenance schedule, description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
- 4. Warranty Manual:
  - a. Manufacturer's warranty statements on each product.
  - b. Date of substantial completion and ending dates for warranties for each group of products.
  - c. Software registration and licenses.
- 5. Include any other pertinent data generated during the Project or required for future service.
- 6. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

#### **1.11 DELIVERY, STORAGE, AND HANDLING**

- A. Products shall ship and be stored in their original container to prevent damaging or entrance of foreign matter.
- B. Provide protective covering during construction to prevent damaging or entrance of foreign matter.
- C. Replace, at no expense to Owner, product damaged during storage, handling, or the course of construction.

#### **1.12 PROJECT CONDITIONS**

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

#### **1.13 FINAL TESTING AND OBSERVATION**

- A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Consultant.
- B. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.

#### **1.14 WARRANTY**

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost associated with this warranty repair is the responsibility of the Contractor.
- B. This warranty is in addition to any specific warranties issued by Manufacturers for greater periods of time.



- C. Within the warranty period, answer service calls within twenty-four (24) hours during normal working hours and correct the deficiency within forty-eight (48) hours.
- D. During the warranty period, the Manufacturer shall provide a toll-free 24-hour-per-day number for telephone technical support and service request. If callback is required, calls shall be answered within thirty (30) minutes.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of product function, performance, and quality. Products or manufacturers listed herein are listed in no particular order or preference.
- B. Refer to General and Supplementary Conditions and Division 1 Specification Sections for equipment substitution procedure. Substitution of any equipment within this specification shall require review and approval by the Consultant.
- C. Substitution of specified products with other qualified manufacturers and products will be considered providing:
- D. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
- E. Sufficient data of the products is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
- F. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- G. Providing product not specifically specified without prior written approval by the Owner, Architect, and/or Architect's Consultant shall not be accepted.

### **2.2 GENERAL**

- A. Products shall be new, free from defects and listed by an NRTL when an applicable NRTL Standard exists. Provide product of a given type from one manufacturer.
- B. Provide product of a given type from one manufacturer.
- C. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

### **2.3 CABLING AND ACCESSORIES**

- A. All cable shall be compliant with NEC and NRTL listed. Any NRTL listing must be available at the time of bid.
- B. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g., CMR, CMP, etc.)
- C. Cable shall carry appropriate fire rating (e.g., CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.

- D. Where cables are routed through cable tray, provide tray rated cable of equal specification.
- E. Where cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
- F. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
- G. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from Carol, Liberty, and West Penn are also acceptable provided they meet the performance specifications of the approved listed cables.
- H. DMX512 (E-DMX) distribution cable:
  - 1. Provide 24 AWG four twisted pair data cable.
  - 2. Pair Color Code Chart:
    - a. 1 – White/Blue Stripe and Blue
    - b. 2 – White/Orange Stripe and Orange
    - c. 3 – White/Green Stripe and Green
    - d. 4 – White/Brown Stripe and Brown
  - 3. Insulation: Polyolefin
  - 4. Inner/Outer Jacket Material: PVC – Polyvinyl Chloride
  - 5. Nominal Impedance: 100 ohms.
  - 6. Nominal Velocity of Prop.: 72%
  - 7. Capacitance between conductors: 15.0 pF/ft.
  - 8. Acceptable product:
    - a. Belden 1583A (Category 5E).
- I. DMX512 (E-DMX) distribution cable – Stage Electric Drops:
  - 1. Provide extra rugged, flexible control cable (Ethernet) for connection of NET outlets on grid to electric batten distribution.
  - 2. Cable to be four-pair, double shielded, low-capacitance.
  - 3. Conductors: 26 AWG tinned, annealed copper stranded 7 x 0.16.
  - 4. Connector: Provide with EtherCon connector by Neutrik®.
  - 5. Assembly: pairs cabled with Kevlar strength member.
  - 6. Shield: (inner) aluminum/Mylar, 100% coverage (outer) tinned copper braid, 80% coverage.
  - 7. Conductivity: 15ohms per 100 meters @ 20C.
  - 8. Impedance: 100 ± 15 ohms 1-100MHz.
  - 9. Acceptable product:
    - a. TMB & Associates ProPlex or equivalent.
- J. DMX512 Backup Control Signal Distribution Cable:
  - 1. Provide 24 AWG two twisted pair cable.
  - 2. Insulation: Foam polyethylene.
  - 3. Shield: aluminum foil/polyester tape.
  - 4. Capacitance between conductors: 12.5 pF/ft.
  - 5. Acceptable product:
    - a. Belden 9729
- K. Architectural Lighting DMX Cable:
  - 1. Provide 24 AWG two twisted pair cable.
  - 2. Insulation: Foam polyethylene.
  - 3. Shield: aluminum foil/polyester tape.
  - 4. Capacitance between conductors: 12.5 pF/ft.
  - 5. Acceptable product:

- a. Belden 9842
  
- L. Preset Station Signal Distribution Cable:
  - 1. Provide 16 AWG single twisted pair cable.
  - 2. Insulation: PVC-polyvinyl chloride.
  - 3. Shield: unshielded.
  - 4. Capacitance between conductors: 33 pF/ft.
  - 5. Acceptable product:
    - a. Belden 8471
  
- M. Multi-Conductor SO Type Cable:
  - 1. Provide multi-conductor cable with black neoprene jacket.
  - 2. Conductivity: not less than 98%.
  - 3. Conductor: soft drawn annealed stranded copper.
  - 4. Minimum Conductor Temperature: 90° C.
  - 5. Size: No. 12 AWG minimum.
  - 6. No. of Conductors: As required by circuits shown.
  - 7. Acceptable product:
    - a. Cole Wire & Cable
    - b. Carol
    - c. Rome

## 2.4 POWER DISTRIBUTION

- A. Wall-Mounted Motorized Breaker Panels (MBP)
  - 1. General
    - a. Breaker Panels shall be UL Listed,
    - b. Breaker Panels shall consist of a main enclosure with 12, 24, or 48 pole breaker subpanels, integral control electronics for low voltage terminations and provision for accessory cards
    - c. The panel shall be constructed of 16-gauge galvanized steel. All panel components shall be properly treated or finished in fine-textured, scratch resistant paint
    - d. The unit shall provide interior cover over the control electronics and accessory cards to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components
    - e. Circuits as described in schedule
    - f. Breakers shall provide manual switching control while power is unavailable
  - 2. Each panel shall have a keypad and LCD display for rack configuration, backup, and fault indication.
  - 3. Panels shall employ USITT DMX-512 control format.
  - 4. An Ethernet connection shall provide advanced control of relays over streaming ACN (sACN) and transmit status, control override, and measured energy usage per branch circuit via an internal Web UI or central monitoring interface
  - 5. The panel shall have a UL924-listed contact input for use in Emergency Lighting systems.
  - 6. Electrical
    - a. Breaker Panels shall be available to support power input from:
      - 1) 120/208V three phase 4-wire plus ground
    - b. Breaker panels shall support main circuit breaker options:
    - c. As required for functional system based on existing electrical service or Division 26 documents
  - 7. Breaker Panel Accessories
    - a. A low voltage 0-10V dimming option shall provide up to 24 0-10v control outputs that are linked to relay circuits within the panel. Each output shall support up to 400mA of current sink per output

- b. A contact input option shall provide 24 dry contact inputs to be linked for direct or group relay control, to activate a preset, or to activate a sequence. Controller software shall allow for normally open maintained, normally closed maintained, or momentary toggle
  - 8. Provide with main disconnect breaker option.
  - 9. Quantity: As shown in drawings
  - 10. Acceptable Product
    - a. Lyntec - LCP Series Lighting Control Panelboards
    - b. Strand Lighting – Contact Relay Panel
    - c. Electronic Theatre Controls – Sensor IQ Panel
- B. Distribution Wiring Devices
- 1. General
    - a. All power distribution devices overall assembly shall be listed by a nationally recognized test lab.
    - b. All dimmed circuit connectors shall be 20A grounded stage pin type. All switched circuits connectors shall be 20A twistlock type. All connector types provided shall be of a single manufacture.
    - c. All pigtails shall be three-wire type “SOW” rubber jackets cable. All pigtails to be provided with proper strain relief.
    - d. All power distribution devices shall be fabricated from minimum 18-gauge galvanized steel and finished in black fine-textured powder coat paint unless noted otherwise. Boxes shall be free from burrs, sharp corner, and overhanging edges.
    - e. Circuits for Raceways and Plugging Boxes shall be labelled with 2” yellow on black Brady numbers. Numbers shall be located so that they are no obscured by cabling. Circuits shall be assigned and labelled per schedules on drawings
    - f. Circuits for Wall Boxes and Floor Pockets shall be labelled with 1” yellow on black Brady numbers. Numbers shall be located so that they are no obscured by cabling. Circuits shall be assigned and labelled per schedules on drawings. As a rule, circuits shall number Stage Left to Stage Right, Down stage to Upstage.
    - g. All power distribution devices shall be provided with appropriate mounting hardware.
    - h. All multi-conductor cable is to be provided with Kellems-type strain relief grips at each end of the cables with intermediate strain relief as required.
    - i. Provide connector strips, gridiron junction boxes (GIJB), and associated hardware for over the stage lighting. Coordinate connector strip lengths for electrics with the theatrical rigging equipment. Provide all multi-conductor cables allowing the devices to fly to a low trim as indicated on the TR sheets. The cable is to be provided with necessary cable strain relief grips as part of the cable management system. Provide rugged network control cables to parallel the multi-conductor cable runs. Verify all electrical circuits and label all circuit numbers as specified.
  - 2. Wall Mounted Boxes (WB)
    - a. Provide a wall plug-box designed for recessed mounting.
    - b. Construction: code gauge steel.
    - c. Connectors: female 20 Ampere twistlock-type connectors surface mounted in the plug-box.
    - d. Circuits: number of circuits as specified on drawings.
    - e. Labeling: circuits are labeled with yellow letters on black background.
    - f. Overall assembly UL listed.
    - g. Quantity: As shown in drawings.
    - h. Acceptable product:
      - 1) Altman 450 series
      - 2) ETC 9200 series
      - 3) SSRC RM series
  - 3. Pipe Mounted Boxes (PB)
    - a. Provide a plug box designed for pipe mounting.

- b. Construction: code gauge steel.
  - c. Pigtails: SO type cable. Provide lengths as shown on drawings.
  - d. Connectors: female 20A twistlock connectors on the end of each of the pigtails and flush mounted 20A parallel blade receptacles for convenience circuits.
  - e. Circuits: number of circuits as specified on drawings.
  - f. Labeling: circuits are labeled with yellow letters on black background.
  - g. Overall assembly UL listed.
  - h. Quantity: As shown in drawings.
  - i. Acceptable product:
    - 1) Altman 450 series
    - 2) ETC 9300 series
    - 3) SSRC PM series
4. Gridiron Junction Boxes (GJB)
- a. Provide a junction box designed to mount to the gridiron structure.
  - b. Construction: 16-gauge, cold rolled steel with removable covers.
  - c. Size: minimum 18"W X 6"H X 12"D with four mounting holes. Box will be provided to properly to accommodate number of circuits specified on drawings.
  - d. Finish: fine-texture, scratch resistant, black-powder coating.
  - e. Termination: barriered, screw clamp type terminal strip(s). Terminals to be sized for the circuit, according to the circuit amperage as required.
  - f. Grounding: junction box will have grounding lugs.
  - g. Up to two (2) GIJBs may be required per stage electric; reference circuit count per drawings.
  - h. Overall assembly UL listed.
  - i. Provide Kellems-type grips for each multi-conductor cable entering the junction box.
  - j. Acceptable product:
    - 1) Altman GJB series
    - 2) ETC 8700 series
    - 3) SSRC GB series
5. Distribution Raceway (R)
- a. Provide a connector strip style connector device designed for mounting to pipe battens. Unit is to have a barrier strip for use in conjunction with control network distribution.
  - b. Construction: 16-gauge, cold-rolled steel with removable covers.
  - c. Size: approximately 4"X4" in section, provided in lengths as shown on TR drawings.
  - d. Finish: fine texture, scratch resistant, black powder coat.
  - e. Bracket: provide (1) steel hanging bracket for every five (5) feet of strip.
  - f. Connectors: flush mounted female 20A twistlock receptacles for performance circuits and flush mounted 20A parallel blade receptacles for convenience circuits
  - g. Circuits: number of circuits as specified on drawings with labels on both sides of connector strip.
  - h. Termination: circuits terminated at a barrier terminal strip in a terminal box located, as specified on drawings.
  - i. Overall assembly UL listed.
  - j. Quantity: As shown in drawings
  - k. Acceptable product:
    - 1) Altman 450 series
    - 2) ETC 9900 series
    - 3) SSRC BAL series
6. SO Cable Cradles:
- a. Provide properly sized cable cradles for SO cable service from gridiron junction box to plug-strip connector device.
  - b. Acceptable product:
    - 1) ETC 8800 Series

- 2) Altman 512 Series.
7. SO Cable Kellems-type Grips:
  - a. Provide properly sized Kellems-type grips for SO cable service from gridiron junction box to plugstrip connector device.
  - b. Quantity: As required for the specified number of circuits
  - c. Acceptable product:
    - 1) Hubbell or equivalent.

## 2.5 CONTROL EQUIPMENT

- A. Control Distribution Panel (CDP)
  1. Provide wall-mounted unit to house components within as described on the drawings
  2. Provide a low profile, wall mounted NEMA 1 enclosure constructed of 16 gauge steel.
  3. Enclosure shall have a hinged, locking door of same construction.
  4. Enclosure shall be properly vented to maintain acceptable equipment operating temperature.
  5. Enclosure shall be sized to house all necessary components for the lighting control network.
  6. Provide an integrated rack rail system to accommodate adjustable and easy mounting of network components.
  7. Rails shall be constructed of 11 gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
  8. Enclosure shall have cable management features including pass-through on back pan, sufficient cable tie points and knockouts on top, bottom and sides.
  9. Enclosure shall have a powder coat finish. Color per Manufacturer's standard.
  10. Enclosure shall be UL listed.
  11. Quantity and details: As shown on drawings
  12. Acceptable product:
    - a. ETC DIN14 or DIN28 Enclosure
    - b. Pathway 1100 Series Enclosures
    - c. Strand Lighting Vision.NET DIN Rail Enclosure
- B. UPS Backup Power / Surge Protection
  1. Provide a rack mountable UPS backup to support equipment located in the control distribution racks (provide with one (1) spare battery).
  2. Output Power Capacity: 1400VA/1050W
  3. Provide a DIN rail mountable UPS backup to support equipment located in the control distribution panel (provide with one (1) spare battery).
  4. Output Power Capacity: 500VA/120V
  5. Input 120V/ Output 120V
  6. Interface Port: DB-9 RS-232
  7. Extended runtime model
  8. Rack Height: 2 Units
  9. Filtering: Full time multi-pole noise - filtering: 0.3% IEEE surge let-through: zero clamping response time: meets UL 1449
  10. The UPS shall be provided by the lighting control system manufacturer.
  11. Quantity: As shown in drawings.
  12. Acceptable product:
    - a. APC
    - b. Tripp Lite
    - c. Middle Atlantic
- C. Control Components
  1. Ethernet Switches (ESW)

- a. Provide business grade Gigabit PoE+, Layer 2 managed Ethernet switches in the CDP as shown in the TL series documents.
  - b. Switch shall include 24 POE+ ports meeting IEEE802.3at standard
  - c. Switch shall include port routing via separate VLAN subnets
  - d. Switch shall be equipped with LED indicators for power status, port status, bandwidth utilization, collision detection and speed indication.
  - e. Switch shall have a built-in web-based management interface to provide easy to use management through a standard browser. Provide with all required software management tools.
  - f. Provide DIN rail mount kit and required hardware and cables for stacking.
  - g. Each network location shall have a dedicated input point on the network switch. Dedicated input points shall be clearly labeled to identify connected network device at the patch panel. Patching shall not be required.
  - h. Ethernet switch shall be tested and approved by Lighting Control System Manufacturer for compatibility with all connected devices.
  - i. Quantity: As required by design
2. Network Node/Gateway
- a. Provide rack-mounted DMX Ethernet node/Gateway to generate DMX to devices located at theatrical and house architectural lighting positions
  - b. Nodes shall have (4) screw terminal or 5-pin DMX connectors for a total of 4 DMX universes for distribution over the Ethernet system.
  - c. DMX Node shall have LEDs for indication of power, network activity, and DMX port configuration.
  - d. Each input shall route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
  - e. Quantity: As required by design.
  - f. Acceptable product:
    - 1) Pathway rack or DIN rail mounted gateway
    - 2) Strand Lighting rack or DIN rail mounted gateway
    - 3) ETC rack or DIN rail mounted gateway
- D. Plates and Devices
1. DMX512 Distribution Box/Network Gateway (NN2):
    - a. Provide a plug-in box designed for pipe mounting.
    - b. Node shall provide the quantity of universes, as specified, of DMX512 control for intelligent lighting or other DMX512 addressable devices.
    - c. Power for the node shall be provided over the Cat6 cable via the network switch. All nodes shall be IEEE 802.3af compliant and UL listed. Power consumption shall not be greater than 3 watts.
    - d. Ports:
      - 1) DMX Ports shall comply with the requirements of the USITT DMX512.
      - 2) The DMX port shall be software-configurable for either input or output.
      - 3) DMX inputs shall be fully opto-isolated from the node electronics and from each other.
      - 4) DMX outputs shall be earth-ground referenced.
      - 5) DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
    - e. Node modules will mount within a standard electrical box or enclosure.
    - f. Each input shall route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
    - g. Quantity: As shown in drawings.
    - h. Acceptable product:
      - 1) Pathway Connectivity Pathport Node
      - 2) Strand Lighting Node
      - 3) ETC DMX Node
  2. Portable Network Gateways:

- a. Provide portable output nodes and input node for pipe mounting at any NET station.
  - b. Each node shall be equipped with a molded RJ 45 connector on a jacketed cable (see specification for flexible Category 6 cable) for connection to the lighting control network (NET).
  - c. Node shall provide the quantity of universes, as specified, of DMX512 control for intelligent lighting or other DMX512 addressable devices.
  - d. Power for the node shall be provided over the Category 6 cable via the network switch. All nodes shall be IEEE 802.3af compliant and UL listed. Power consumption shall not be greater than 3 watts.
  - e. Ports:
    - 1) DMX Ports shall comply with the requirements of the USITT DMX512.
    - 2) The two DMX ports shall be software-configurable for either input or output.
    - 3) DMX inputs shall be fully opto-isolated from the node electronics and from each other.
    - 4) DMX outputs shall be earth-ground referenced.
    - 5) DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
  - f. Double Universe Node shall contain the following components:
    - 1) RJ 45 connector. Connector is to be RJ Lxxx model ENSAM315.
  - g. Provide C-clamp for pipe mounting.
  - h. Quantity: (1) Output Nodes and (1) Input Nodes
  - i. Acceptable product:
    - 1) Pathway Connectivity Pathport Node
    - 2) Strand Lighting Node
    - 3) ETC Portable DMX Node
3. DMX512 Distribution (DMX):
- a. Provide DMX512 distribution for connection to wiring devices in the Classroom and Auditorium.
  - b. Modules shall provide one optically isolated DMX512 signal output capable of driving thirty-two (32) receiving devices on a single DMX line.
  - c. Provide a wall plugging box designed for surface mounting.
  - d. Construction: code gauge steel.
  - e. Connectors: Neutrik 5 conductor XLR, flush mounted.
  - f. Circuits: located as shown on the drawings.
  - g. Labeling: labeled with yellow letters on black background.
  - h. Quantity: As shown in drawings.
  - i. Acceptable product:
    - 1) Pathway Connectivity station
    - 2) Strand Lighting station
    - 3) SSRC station
    - 4) ETC station
4. Control Receptacle Station (CR#)
- a. Provide a flush-mounted control station for connection of the control console over network.
    - 1) Provide DMX receptacle as described on the drawings.
  - b. Station will contain receptacle components as described on the drawings.
  - c. Station faceplates shall be .80" aluminum, finished in fine texture, scratch resistant black powder coat.
  - d. Station Back box will be a minimum of 2.5 inches deep
  - e. Station shall have white, silk screened graphics
  - f. Provide a Lamacoid label for network jacks that denotes, using alpha-numeric labelling convention, the switch location and network port number.
  - g. Each network jack shall route directly to the Ethernet switch without the need for patching.
  - h. No daisy-chaining between jacks or splicing on network cabling is allowed.



- i. Quantity: As shown in drawings.
- j. Acceptable product:
  - 1) Pathway Connectivity station
  - 2) Strand Lighting station
  - 3) SSRC station
  - 4) ETC station

## 2.6 CONTROL CONSOLE AND ACCESSORIES

### A. Overview

1. Provide a control console for direct operation of theatrical fixtures and development of user-presets to be stored for recall via the Architectural Control Sub-system specified in this section.
2. Provide initial setup as directed as part of the system commissioning process.

### B. Control Console

1. The lighting control console shall be a microprocessor-based system specifically designed to provide complete control of stage, studio, and entertainment lighting systems.
2. The system shall also be able to control third party ACN devices directly. The system shall provide control of 1,024 or 6,144 outputs on a maximum of 32,768 control channels.
3. A maximum of 10,000 cues, 999 cue lists, 1000 groups, 1000 presets, 4 x 1000 palettes (Intensity, Focus, Color and Beam), 1000 effects, 1000 macros and 100 curves may be contained in non-volatile electronic memory and stored to an onboard hard disk or to any USB storage device.
4. The console may be placed in Tracking or Cue Only mode by the user as a system default and overridden on individual record actions as required.
5. A Master Playback fader pair and dedicated Grand Master/Blackout shall be provided.
6. A high-resolution level wheel shall be provided to control intensity for selected channels and scrolling within selected displays. Four page-able high-resolution encoders shall be provided for control of other non-intensity parameters. Non-intensity parameters shall be controllable via the encoders or keypad controls, without need of an external pointing device.
7. Control and programming features for automated fixtures shall also include: a standard library of fixture profiles, the ability to copy and edit existing profiles and create new profiles, patch displays including channel and output addressing, 16-bit fade resolution, color characterization allowing color mixing and storing in Hue and Saturation or native device values.
8. The system shall direct user input through on-screen dynamic prompts and integral LEDs on console keys indicating current operating mode. A context sensitive on-line Help feature shall explain and provide an example of the operation of each feature of the system.
9. A row of softkeys shall be provided, which change function based on the selection and context of the console. These softkeys shall be labeled via an adjacent LCD display that shows their current functions at all times. Systems using softkeys with no LCD display shall not be acceptable.
10. Console software upgrades shall be made by the user via a USB port; changing internal components shall not be required.
11. The console operating software shall be loaded into program execution memory from the internal hard drive when the console is powered. In the event of an uncontrolled shutdown, the console shall return to its last output state when power is restored.
12. Console power shall be 95 – 240V AC at 50 or 60Hz, supplied via a detachable power cord.
13. Accessories:

- a. Provide (2) external touchscreens high resolution DVI monitors that will display system information, including playback status, live output and blind values for all record targets.
  - b. Provide (1) fully-functioning, detachable alphanumeric keyboard. The keyboard shall allow labeling of channels, cues, presets, groups, palettes, effects, macros, curves and the show. An integral electronic keyboard shall be provided.
  - c. Provide with dust cover
  - d. Provide with USB mouse
  - e. Provide with 25' network control cable
  - f. Provide (1) Littlite with 3-pin XLR connector
  - g. Provide (1) USB jump drive, minimum 8gb
14. Quantity: (1)
15. Acceptable product:
- a. Electronic Theater Controls Element 2 with 1,024 channels of control

C. Rolling Storage/Operator Cart

1. Provide a portable storage and operator cart for the control console.
2. Nominal dimensions shall be 41" W x 26" D x 40" H.
3. Unit shall include the following options:
  - a. 19" equipment rack frame sized for 10RU
  - b. 35" locking aluminum keyboard drawer
  - c. (4) 8" swivel casters with brakes and position locks.
  - d. (1) removable side panel
  - e. (1) flip-up side panel extension
  - f. Top desk surface to include:
    - 1) Dual post, articulating monitor mount
    - 2) Power connections for (3) AC outlets and (1) dual USB charger
4. Quantity: (1)
5. Acceptable product:
  - a. Bigfoot Mobile Systems "Side Operator" XL cart

## 2.7 ARCHITECTURAL CONTROL SYSTEM

- A. Processing – Provide either a rack mounted control processor located in the control distribution rack or provide distributed processing at each control station.
1. The processing rack shall receive output data from a lighting control console and/or architectural control stations, process the information it receives and distribute the information to DMX-controlled panels and devices.
  2. Processing Racks shall be designed to support the following wire terminations:
    - a. AC (single phase)
    - b. Echelon link power
    - c. 24Vdc
    - d. DMX512 In
    - e. DMX512 Out
    - f. RS232 Serial In/Out
    - g. Net3 Unshielded Twisted Pair (UTP) or ST fiber optic
  3. Coordinate integration of audio-visual system with contractor and program system as directed by the End User.
- B. Configuration – Configure architectural control system screens in conjunction with User prior to commissioning. Base configuration shall accommodate the following basic layouts:
1. Main Navigation
  2. User configurable named presets (2 pages to be programmed at training)
  3. Work light individual control
  4. Work light presets

- C. Stations - General
  - 1. Master stations shall be located in the control booth, backstage and as noted on the contract documents.
  - 2. Provide preset stations as described below and shown in drawings.
  - 3. All audience exposed switches shall be provided with locking covers and shall be painted a custom color as determined by the architect.
  
- D. Acceptable product:
  - 1. Electronic Theatre Controls Echo with DMX Scene Controller
  - 2. Strand Lighting Vision.net
  - 3. Interactive Technologies CueServer2
  
- E. DMX Control Interface
  - 1. Provide a DIN-rail mounted DMX interface to allow snapshot capture of lighting presets via the DMX input stream.
  - 2. The control interface shall support:
    - a. Recall of prerecorded scenes for playback using DMX.
    - b. Preset playback as activated by any connected control station.
    - c. DMX pass-through for real-time output of incoming DMX levels.
    - d. Live control and recording for multiple DMX fixture profiles.
  - 3. Provide control network interface, power supply, and cabling as required.
  - 4. Station shall be compatible with associated time clock and master station controls.
  - 5. Quantity: As required for design.
  - 6. Acceptable Product:
    - a. ETC Echo DMX Scene Controller
    - b. Strand Lighting Vision.net DMX Interface
    - c. Approved equal
  
- F. Control Stations
  - 1. Wall Mount Console - HLM
    - a. The Touchscreen protocols station shall provide control of up to 512 local or networked DMX addresses. Addresses may be distributed using DMX512-A, via sACN, or Art-Net.
    - b. Touchscreen stations shall consist of a seven-inch, backlit LCD with capacitive multi-touch interface
    - c. Flush-mount to industry standard 3-gang back box
    - d. The Touchscreen shall have an RJ45 Ethernet port for connection to a lighting system and for Power over Ethernet (PoE)
    - e. The Touchscreen shall provide a USB port allowing show data to be saved for archival or transfer to other consoles or a personal computer
    - f. The Touchscreen shall support patching, address setting, and mode changes using Remote Device Management (RDM) on the local DMX/RDM port
    - g. Touchscreen playback control shall be capable of:
      - 1) Seven user customizable interactive pages
      - 2) Interactive color picker
      - 3) Virtual level wheel
      - 4) Rearranging and re-programming preset tiles
    - h. Screen backlight shall dim or turnoff when not in use
    - i. Quantity: As shown on drawings.
    - j. Acceptable product:
      - 1) ETC EchoTouch
      - 2) Strand Lighting Vision.NET
      - 3) Interactive Technologies CueServer3 Insite Touchscreen
  - 2. Push Button Preset Stations (HL5)
    - a. Provide five and ten push button stations as shown on drawings
    - b. Stations shall be mounted within a one-gang back box

- c. Station finish shall be black in technical areas color selected by Architect for public spaces.
- d. Five button stations (HL5) shall have four programmable presets plus off. Presets may include house lights, work lights, blue lighting and will be programmed with the User.
- e. Quantity: As shown on drawings.
- f. Acceptable product:
  - 1) Electronic Theatre Control Echo Preset Stations
  - 2) Interactive Technologies CueStation: Ultra stations
  - 3) Strand Lighting Vision.net

## 2.8 PORTABLE LIGHTING FIXTURES AND ACCESSORIES

- A. Provide and integrate the following equipment into the project.
  - 1. Theatrical Lighting Fixtures
    - a. The portable lighting fixtures shall connect and be controlled by the new theatrical lighting control system.
    - b. All fixtures shall be listed by UL or an OSHA approved NRTL.
    - c. Fixtures shall be constructed of rugged die cast aluminum with high impact knobs and handles unless otherwise noted.
    - d. Fixtures shall be provided with a black finish unless otherwise noted.
    - e. Fixtures shall have a rugged steel yoke with a positive locking clutch which will allow for a 300° body rotation.
    - f. All fixtures shall be provided with color frame, power lead with mating grounded connector, safety cable, and c-clamp.
    - g. Fixtures shall be:
      - 1) Labeled with the Owner's mark and select numbering/labelling inventory scheme.
      - 2) Bench-focused, if necessary.
      - 3) Hung in the Owner's selected stock plot.
      - 4) Patched at the console.
- B. LED-type fixtures
  - 1. Provide (1) power pass-through and (1) DMX extension cable at 10 ft. length for each LED-type fixture included in the inventory. All cables shall adhere to requirements set for below in Cables and Accessories portion of this specification.
  - 2. All LED-type fixtures shall support ANSI E1.11 DMX512-A and ANSI E1.20 RDM standards.
  - 3. All LEDs used in the product shall be high brightness and proven quality from established and reputable LED manufacturers.
  - 4. Manufacturer of LED emitters shall utilize an advanced production LED binning process to maintain color consistency.
- C. Fixtures – Type and Quantity
  - 1. Type 1 – Color-changing LED Zoom-style Profile
    - a. Provide an RGBL color mixing high-intensity LED illuminator with DMX controlled intensity and color;
    - b. Unit shall have a shutter assembly with (4) blades mounted in two or more planes. Shutter blades shall be warp and burnout resistant;
    - c. Unit shall have two accessory slots, a top-mounted quick release gel frame retainer, and a slot with sliding cover for motorized pattern devices or optional iris.
    - d. Unit shall have projector-like quality pattern imaging, sharp shutter cuts without halation, and allow for both hard and soft beam edges;
    - e. Unit shall operate at 100V to 240V 50/60 Hz and utilize an internal power supply;
    - f. Provide power lead with twistlock connector;
    - g. Unit shall support power and DMX in and thru connections;

- h. Unit shall utilize an integral 25° -50° adjustable lens assembly;
        - i. Quantity: (36)
        - j. Acceptable product:
          - 1) ETC ColorSource Spot jr Deep Blue
          - 2) Strand Lighting Acclaim LED Zoomspot
          - 3) Chauvet Ovation E2-FC
    - 2. Type 2 – Color-changing LED Wash
      - a. Provide an RGBL color mixing high-intensity LED illuminator with DMX controlled intensity and color;
      - b. Unit shall have an accessory slot with a top-mounted quick release gel frame retainer.
      - c. Unit shall operate at 100V to 240V 50/60 Hz and utilize an internal power supply.
      - d. Provide power lead with twistlock connector;
      - e. Unit shall support power and DMX in and thru connections.
      - f. Provide one (1) NSP, MFL, and WFL round field lens with each fixture.
      - g. Quantity (12)
      - h. Acceptable product:
        - 1) ETC ColorSource PAR Deep Blue
        - 2) Strand Lighting Acclaim LED Fresnel
        - 3) Chauvet Ovation P-56FC
    - 3. Type 3 – Color-changing LED Strip
      - a. Provide an RGBL color mixing high-intensity LED illuminator with DMX controlled intensity and color;
      - b. Unit shall utilize all-metal extruded housing with advanced thermal management systems for long LED life
      - c. Unit shall utilize optional interchangeable lens accessory kits to adjust fixture beam angle.
      - d. Unit shall operate at 100V to 240V 50/60 Hz and utilize an internal power supply.
      - e. Provide power lead with twistlock connector;
      - f. Unit shall support power and DMX in and thru connections;
      - g. Provide trunnion with c-clamps hanging bracket mounting for each fixture;
      - h. Provide two (2) of each lenses as noted per fixture:
        - 1) Medium Round
        - 2) Wide Round
        - 3) Extra Wide Round
      - i. Quantity: (12)
      - j. Acceptable product:
        - 1) ETC ColorSource Linear 2 Deep Blue
        - 2) Strand Lighting AURORA LED 4-cell
- D. Type 4 – LED Stage Electric Work Lights
  - 1. Provide a high output LED work light capable of clamping onto the top batten of the stage electrics.
  - 2. Construction: Heavy duty anodized extruded aluminum housing. All materials shall be corrosion resistant.
  - 3. Rating: 120/240 volts AC/DC operation.
  - 4. Cable: 36" Teflon leads encased in black fiberglass sleeving.
  - 5. Connectors: (1) male parallel blade
  - 6. Yoke: Rigid flat steel with locking dog tilt handle.
  - 7. Finish: All black enamel
  - 8. Provide with yoke and c-clamp hardware
  - 9. Quantity: (3)
  - 10. Acceptable product:
    - a. Altman LED Work Light
- E. Cables and Accessories

1. Extension Cables:
  - a. Provide extension cables for extending pigtail or wall box circuits to lighting instrument.
  - b. Provide cable and connectors which meet or exceed the quality of cables and connectors set forth in this specification.
  - c. Provide each cable with Velcro cable tie.
  - d. Provide extension cable assemblies consisting of 12-gauge, 3 conductor flexible cable and 20A rated male and female grounded twist-lock connectors.
  - e. Quantity:
    - 1) (15) @ 10 ft.
    - 2) (5) @ 25 ft.
  - f. Acceptable Products:
    - 1) TMB & Associates ProPower
    - 2) Lex Products PowerFLEX
    - 3) Or approved equal
2. Adapter Cables
  - a. Provide adapter cables for extending pigtail or wall box circuits to lighting instrument.
  - b. Provide cable and connectors which meet or exceed the quality of cables and connectors set forth in this specification.
  - c. Provide each cable with Velcro cable tie.
  - d. Provide extension cable assemblies consisting of 12-gauge, 3 conductor flexible cable and 20A rated male Edison connectors and female grounded twist-lock connectors.
  - e. Quantity:
    - 1) (6) @ 1ft. with Male Edison and female twist-lock connectors
    - 2) (6) @ 1ft. with Male twist-lock and female Edison connectors
  - f. Acceptable Products:
    - 1) TMB & Associates ProPower
    - 2) Lex Products PowerFLEX
    - 3) Or approved equal
3. DMX-512 cable
  - a. Provide DMX-512 cables for connecting lighting consoles, moving lights, or other DMX controlled accessories to the Network Nodes.
  - b. Connectors shall be Neutrik 5-pin.
  - c. Provide 24AWG two twisted pair data cable.
  - d. Insulation: polyethylene.
  - e. Nominal Impedance: 100 ohms.
  - f. Nominal Velocity of Prop.: 78%.
  - g. Capacitance between conductors: 12.5 pF/ft.
  - h. Quantity:
    - 1) (15) 10' DMX Cable
    - 2) (5) 25' DMX Cable
  - i. Acceptable Products:
    - 1) TMB & Associates ProPlex
    - 2) Lex Products PowerFLEX
    - 3) Or approved equal
4. Flexible Category 5e Cable/NET Cable:
  - a. Provide extra rugged, flexible control cable (Ethernet) for connection of NET stations to portable Network Nodes.
  - b. Cable to be 4-pair, double shielded, low-capacitance.
  - c. Conductors: 24 AWG tinned, annealed copper stranded 7 x 0.16.
  - d. Connector: Provide with EtherCon connector by Neutrik
  - e. Assembly: pairs cabled with Kevlar strength member.
  - f. Shield: (inner) aluminum/Mylar, 100% coverage (outer) tinned copper braid, 80% coverage.

- g. Conductivity: 15ohms per 100 meters @ 20C.
  - h. Impedance: 100 ±15 ohms 1-100 MHz
  - i. Quantity:
    - 1) (4) 3' Ethernet Cable
    - 2) (4) 10' Ethernet Cable
    - 3) (4) 25' Ethernet Cable
  - j. Acceptable Products:
    - 1) TMB & Associates ProPlex
    - 2) Lex Products PowerFLEX
    - 3) Or approved equal
5. XLR DMX Terminator
- a. Provide XLR DMX male terminator
  - b. Connector shall be Neutrik 5-pin.
  - c. Termination resistance: 120 ohms +/- 10% between pins 2 and 3
  - d. Termination power capacity: 2 watts
  - e. Quantity: (10)
  - f. Acceptable Product
    - 1) ETC SGE 1507
    - 2) Lex Products DMX5P-TERM
6. Tie Line
- a. Product will be a cotton line with polyester core
  - b. The blend will be a diamond braid construction
  - c. Product will be Black in color
  - d. Product will be unglazed
  - e. Product will be 1/8" in diameter
  - f. Product will be on original spool or reel
  - g. Provide 600'-0" spool
    - 1) Cut into 24" ties for dressing cable used in repertory plot
    - 2) Furnish the remainder of unused spool to Owner
  - h. Acceptable product:
    - 1) Rose Brand #4 Tie Line

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. The installation recommendations contained within the Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
- C. Mount equipment and enclosures plumb and level.
- D. Permanently installed equipment to be firmly and safely held in place.
- E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

#### **3.2 INSTALLATION OF CABLE AND WIRING**

- A. Verify installation of electrical work for this scope and all associated equipment with the overall Electrical installation. Provide all necessary equipment, including mounting hardware, for complete connection of power system wiring.

- B. Verify installation of power and ground wiring to equipment. Power and ground wiring will terminate inside of equipment and/or junction boxes and be hardwired to ground buss and circuit breaker to ensure uninterrupted operation.
  
- C. All control wiring will be executed in adherence to ANSI standards including the following:
  - 1. Isolate cables carrying signals at different levels and separate to restrict interaction.
  - 2. Keep wiring separated into three groups of conduit provided for control circuits, power circuits (up to 50 Amps), and feeder circuits (above 50 Amps).
  - 3. Isolate all wiring, except for safety ground wiring, from conduit ground.
  - 4. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic interference in other technical systems (such as sound and communications systems) in the facility. Where possible all devices and wiring will be enclosed in a shielded environment. Take care not to use shields (conduits) and grounds as current carrying return paths for lamp and relay coil commons. All ground references are to be made to the building electrical system ground.
  - 5. Label unused wiring provided for spares or future systems and terminate at screw terminal strips.
  - 6. All joints and connections will be made with resin-core solder or with ratchet jaw crimp type mechanical connectors. Connect all circuits electrically in phase using same wire color code for similar circuits throughout the project.
  - 7. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and restrictions.
  - 8. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
  - 9. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
  - 10. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices
  - 11. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
  - 12. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
  - 13. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
  - 14. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.
  - 15. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
  - 16. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.

### **3.3 INSTALLATION OF EQUIPMENT**

- A. Take appropriate precautions against electrostatic discharge (ESD) when installing electronic equipment.
  
- B. Equipment to be installed in new condition, free of damage, scratches, dents, etc.



- C. Provide adequate ventilation in cabinet mounted equipment to maintain operating temperatures within range recommended by Manufacturer.
- D. All equipment will be installed in compliance with applicable Local and National Codes and Regulations.
- E. Equipment shall be installed in accordance with Manufacturer's requirements.
- F. Install lighting fixtures using standard industry practices. All lamps, lenses, and reflectors will be installed free of dirt, dust, and finger smudges. Do not use bare hands when handling conventional tungsten lamps. Ensure that a safety cable is properly applied with each fixture.
- G. Install lighting instruments to the standard house hang or repertory plot as directed by Consultant. Contractor shall document location of each type of distribution device and circuiting as part of as-built documents on plot. Provide PDF copy of plot to Consultant and Owner. Provide (2) full size printed copies of plot to Owner.

### **3.4 CONTRACTOR COMMISSIONING**

- A. Prior to energizing or testing the System ensure the following:
  - 1. Physical installation is complete.
  - 2. Products are installed in proper and safe manner according to Manufacturer's requirements.
  - 3. Dust, debris, solder splatter, etc. is removed.
  - 4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  - 5. Temporary facilities and utilities have been properly disconnected and removed.
  - 6. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. The jobsite shall be broom clean.
- B. Contractor shall:
  - 1. Retain the services of a Manufacturer certified technician to check the installation and ensure its proper operation. No part of the Theatrical Lighting System may be energized before this technician has checked and approved the System installation.
  - 2. Test all lighting load circuits for the following:
    - a. Continuity
    - b. Nominal voltage
    - c. Polarity
    - d. Accuracy to the Distribution Schedule as enumerated in the drawings.
  - 3. Test controls wiring for the following:
    - a. Appropriate wire types and quantities
    - b. Control wire distance from source
    - c. Terminations meet Manufacturer requirements
- C. The following identifies some, but not all, of the commissioning tasks of the commissioning team. This list is not intended to be comprehensive and should be considered a general guideline for the Contractor without a defined commissioning process statement:
  - 1. Program all power distribution panels
  - 2. Setup and program all network control devices
  - 3. Setup and initial programming of control console
  - 4. Setup and initial programming for all architectural control devices
  - 5. Program all emergency lighting control devices

### **3.5 FINAL OBSERVATION & TESTING**

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Consultant.
- B. Testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide all test equipment noted below. Contractor shall provide at least two (2) technicians available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Testing process is estimated to take a minimum of one (1) day.
- C. Provide the following test gear:
  - 1. Circuit Tester with adapters for all connectors present in the system.
  - 2. Multimeter capable of measurements up to 600V AC/DC, 10A DC, and 2MOhms
  - 3. DMX Tester
  - 4. Industrial Ethernet Tool capable of testing signal continuity and distance from source
- D. The following procedures will be performed on each System:
  - 1. Observation of the physical installation including labeling, mounting, and finish of all equipment and components which are a part of the System.
  - 2. Functional testing of all control devices and devices under control within the System.
  - 3. Review of programming and standard settings for all control interface devices.
  - 4. Load circuit verification.
  - 5. Control circuit verification.
  - 6. Other tests on equipment or systems deemed appropriate.
- E. The Consultant will provide the Owner with a listing describing any incomplete or otherwise deficient items determined as part of the testing process. Where further adjustment or work becomes evident during testing, the Contractor is to continue work until the System is complete.

### **3.6 INSTRUCTION OF OWNER PERSONNEL**

- A. Provide operations and service training on all equipment incorporated in the System.
- B. Training shall not be conducted until final observation and testing is completed by the Consultant, unless otherwise directed by the Owner.
- C. Provide (8) hours of training. Training time shall be conducted in multiple sessions, with each session not to exceed four hours. Training shall be conducted in accordance with Owner's schedule.
  - 1. Six months after completion of initial training, schedule an additional (4) hours with Owner for review of systems and equipment operation.
- D. The major equipment components and subject matter are as follows (advisory percentage of overall time allocated):
  - 1. Power Distribution System (20%)
    - a. Basic testing and control
    - b. Normal and emergency operations
    - c. Programming memory
    - d. Software configurations and upgrades
    - e. Troubleshooting.
  - 2. Control Console (40%)
    - a. Operational training, including offline or remote-access software
    - b. Patching and programming
    - c. Fixture integration
    - d. Peripheral hardware

- e. Applications interface for retrieving information from the control console
  - f. Troubleshooting
  - g. Upgrades
  - 3. Architectural Controls (20%)
    - a. Part of training will be to establish programmed looks for the performance areas with the end-user. The Contractor shall provide all equipment to establish DMX values for preset looks.
    - b. Snapshotting preset onto DMX controller
    - c. Preset recall operation
    - d. Normal operations (e.g., console arbitration, time-clock controlled events, etc.)
    - e. Troubleshooting.
  - 4. Theatrical Lighting Fixtures and Accessories (20%)
    - a. Hang and focus
    - b. Cabling and circuiting
    - c. Setup and DMX addressing
    - d. Troubleshooting
- E. Training Schedules
- 1. Training should be assumed to take place on the project site.
  - 2. Training should be scheduled to be non-overlapping.
  - 3. Actual training schedule shall be by agreement with Owner.
  - 4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, then the training time shall be extended an equal amount of time.
- F. Submit an outline of the course with sample instructional aides for approval thirty (30) days prior to scheduled instruction sessions to architect and architect's consultant.
- G. Following discussions with Owner, provide a Training submittal 2-4 weeks prior to first training. Submittal shall:
- 1. Include a separate page/entry for every training session.
  - 2. Indicate date, time, and approximate length of training session.
  - 3. Indicate person(s) conducting training.
  - 4. Indicate whether training will be video recorded.
  - 5. Intended curriculum and most appropriate attendees (e.g., technician, operations, IT, etc.)
  - 6. Include signature and title lines for:
    - a. Owner acknowledging and accepting training schedule. Include both an Accepted and Rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
    - b. Countersigning by trainer indicating that training actually occurred.
    - c. All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
    - d. Owner's representative attending training at the end of the session shall initial that:
      - 1) Training Occurred.
      - 2) Training Materials were provided and left with Owner
      - 3) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
      - 4) Training was generally sufficient for the proposed curriculum.
  - 7. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)

- H. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.

### **3.7 EVENT ATTENDANCE**

- A. Contractor shall attend the first facility use or event as directed by the Owner.
  - 1. Event Attendance includes the following requirements:
    - a. Attendance shall begin at the first crew call and conclude when the crew is released. During these events perform such tasks (e.g., assistance with patching, programming, troubleshooting cabling problems, etc.) as requested by User. Tasks shall be strictly assistance, not operation.
    - b. Event support personnel shall be a technician associated with the original installation and commissioning.
    - c. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance or as event attendance.
  - 2. Coordinate these schedules with the Owner.

**END OF SECTION 11 61 62**

## **SECTION 11 66 00 - GYMNASIUM EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Requirements including but not limited to:
  - 1. Volleyball equipment.
  - 2. Accessories necessary for a complete installation.

#### **1.3 DEFINITIONS**

- A. NFHS: National Federation of State High School Associations.

#### **1.4 SUBMITTALS**

- A. Product Data: Technical data for each type of product, including assembly, disassembly, and storage instructions for removable equipment and to indicate the performance, fabrication procedures, product variations, and accessories
  - 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
  - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.
  - 1. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, attachments to other work, and operational clearances.
  - 2. Include transport and storage accessories for removable equipment.
- C. Samples: For the following products:
  - 1. Pad Fabric: Wall padding not less than 3 inches (76 mm) square, and corner and column samples not less than 3 inches (76 mm) long, with specified treatments applied. Mark face of material.
- D. Coordination Drawings: Court layout plans, drawn to scale, and coordinated with floor inserts, game lines, and markers applied to finished flooring.
- E. Product Certificates: For each type of gymnasium equipment.
- F. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

#### **1.5 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

## 1.6 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

## 1.7 WARRANTY

- A. Written warranty in which manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 25 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for use and finish type indicated.
  - 1. Extruded Bars, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
  - 2. Cast Aluminum: ASTM B 179.
  - 3. Flat Sheet: ASTM B 209 (ASTM B 209M).
- B. Steel: Comply with the following:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 2. Steel Tubing: ASTM A 500/A 500M or ASTM A 513, cold formed.
  - 3. Steel Sheet: ASTM A 1011/A 1011M.
- C. Support Cable: 1/4 inch (6 mm) diameter, 7x19 galvanized stranded steel wire rope with breaking strength of 7000 lb (3175 kg). Provide fittings complying with wire rope manufacturer's written instructions for size, number, and installation method.
- D. Support Chain and Fittings: For chains used for overhead lifting, provide Grade 80 heat treated alloy steel chains, complying with ASTM A 391/A 391M, with commercial quality, hot dip galvanized or zinc plated steel connectors and hangars.
- E. General Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain, complying with ASTM A 413/A 413M, Grade 30 proof coil chain or other grade recommended by gymnasium equipment manufacturer. Provide coating type, chain size, number, and installation method complying with manufacturer's written instructions.
- F. Castings and Hangers: Malleable iron, complying with ASTM A 47/A 47M; grade required for structural loading.
- G. Softwood Plywood: DOC PS 1, exterior.
- H. Anchors, Fasteners, Fittings, and Hardware: Corrosion resistant or noncorrodible units; concealed; tamperproof, vandal and theft resistant design.
- I. Grout: Nonshrink, nonmetallic, premixed, factory packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C 1107/C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

## 2.2 VOLLEYBALL EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AALCO Manufacturing.
  2. ADP Lemco.
  3. American Athletic, Inc.
  4. Arizona Courtlines, Inc.
  5. Bison, Inc.
  6. Douglas Industries, Inc.
  7. Draper Inc.
  8. IPI by Bison.
  9. Jaypro Sports, LLC.
  10. L. A. Steelcraft Products, Inc.
  11. P. W. Athletic Mfg. Co.
  12. Performance Sports Systems.
  13. Porter Athletic Equipment Company.
  14. Schelde North America.
  15. Spalding Equipment.
  16. Sports Imports.
- B. Floor Insert: Chrome finished steel floor plate; and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, not less than required to securely anchor pipe sleeve indicated; with anchors designed for securing floor insert to floor substrate indicated; quantity as indicated.
1. Floor Plate: Self locking, hinged access cover, designed to be flush with adjacent flooring. Provide one tool(s) for unlocking access covers.
  2. Floor Plate: Self locking, hinged access cover, recessed to accept finish flooring matching and designed to be level with adjacent flooring. Provide one tool(s) for unlocking access covers.
  3. Floor Plate: Lockable swivel access cover, designed for use with floating wood floors and to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
1. Verify critical dimensions.
  2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
  3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation after correcting unsatisfactory conditions.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly where required.

- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, are completed.
- C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
  - 1. Floor Insert Location: Coordinate location with application of game lines and markers , and core drill floor for inserts after game lines are applied.
  - 2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and floor-plate type.

### **3.3 ADJUSTING**

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

### **3.4 CLEANING**

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

### **3.5 DEMONSTRATION**

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

**END OF SECTION 11 66 00**



## **SECTION 12 11 00 - DIGITALLY-PRINTED VINYL WALL GRAPHICS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Very large scale vinyl wall graphics (murals) digitally printed on self-adhesive vinyl graphics film from electronic graphic image files furnished by the Architect, adhered to gypsum board surfaces with a Level 5 skim coated, smooth painted finish.

#### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Installation drawings: Indicate configuration and dimensions of substrate(s) including (if applicable) penetrating and protruding elements; vinyl mural panels; seam locations; details of installation; and related and adjacent work. Note field-measured dimensions.
- B. Product Data:
  - 1. Manufacturers' specifications for vinyl film medium, inks and laminating film, and other data sufficient to demonstrate compliance with specified requirements
  - 2. Manufacturer's written preparation, installation, and cleaning and maintenance instructions and recommendations
- C. Samples:
  - 1. Color Approval Proof:
    - a. Full color laminated print produced with the same equipment that will be used for the actual vinyl wall graphics panels, using the specified resolution, ink sets, vinyl film printing medium and clear protective laminating film, in a size proportional to the finished mural, with the lesser dimension approximately equal to the width of the vinyl film medium.
    - b. Make adjustments, reprint and resubmit as necessary to obtain Architect's approval.
- D. Certificates: Submit written certification, on graphics provider firm's letterhead, that products and installation comply with specified requirements.

#### **1.4 ENVIRONMENTAL CONDITIONS**

- A. Maintain room and substrate temperature and humidity within the ranges recommended by the graphic film manufacturer at least 48 hours prior to, during, and after installation, until Substantial Completion.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, handle and store products as recommended by the manufacturer(s), in graphics provider's labeled protective packaging. Protect from damage and deterioration.

## 1.6 WARRANTY

- A. Graphics provider shall provide a 10-year material and labor warranty against fading, edge lifting, peeling, discoloration, delamination of the overlamine from the vinyl graphics film, and delamination of the vinyl film from the painted Level 5 skim-coated smooth-painted gypsum board substrate.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE PRODUCTS, MANUFACTURERS AND GRAPHICS PROVIDERS

- A. Specifications are based on products, manufacturers and graphics providers named herein or listed as the Basis of Design. Products of manufacturers listed which meet or exceed specifications are approved for use on the Project. Other manufacturers and graphics providers must have a minimum of five years experience supplying (and for graphics providers, installing) products meeting or exceeding the specifications, and comply with requirements of Section 01 25 13 Product Substitution Procedures to be considered.

### 2.2 GRAPHICS PROVIDER

- A. Basis of Design: Riot Creative Imaging division of ARC (Dana LaPointe), 6300 Gulfton, Houston, TX 77081; 713-830-3933; [dana.lapointe@riotcolor.com](mailto:dana.lapointe@riotcolor.com); [www.riotcolor.com](http://www.riotcolor.com)
- B. Single-source Responsibility: Graphics Provider shall be solely responsible for processing, production and installation, whether installation is performed by its own personnel or by its approved installation contractor.

### 2.3 EQUIPMENT

- A. Basis of Design Printer: HP 3000 grand format inkjet printer with HP 881 Latex Printheads; 54 inch wide media capacity; 600 dpi minimum resolution, or equivalent equipment acceptable to the Architect and compatible with the specified (or approved substitution) inks and media.
- B. Laminator: Compatible with the specified (or approved substitution) vinyl film media, inks and overlamine.

### 2.4 MATERIALS

- A. Basis of Design for VWC-Drywall Application:
  - 1. Protective Laminated Film: ClearShield Wall Armor film. Category V Type II.
    - a. Colorfastness: Greater than or equal to 200h.
    - b. Washability: Greater than or equal to 100 cycles.
    - c. Scrubability: Greater than or equal to 300 cycles.
    - d. Abrasion Resistance: Greater than or equal to 300 cycles.
    - e. Cracking, Drying: Good.
    - f. Stain Resistance to Reagents: 4.
    - g. Flame Spread: Less than or equal to 25.
  - 2. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
    - a. Curing: Heat and infrared cured
    - b. VOCs: Less than 294 g/L
    - c. Hazardous Air Pollutants (HAPs): None.
    - d. Hazard Warning Labels: None (cautionary only; no "R" phrases).
    - e. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C

- f.
  - 3. Vinyl Wall Covering: Dreamscape Suede.
    - a. Description: Commercial grade vinyl printable vinyl wallcovering media for modern wide format inkjet printers.
    - b. Construction: Embossed vinyl face with laminated fabric backing.
    - c. Backing: Poly-cotton woven or polyester/pulp non-woven.
    - d. Type Properties: Passes all criterion for WA 101, Type II.
    - e. Thickness: 0.017 in.
  - 4. Accessory products, tools, and equipment: Recommended by, or acceptable to, the manufacturers of the materials with which they are used.
- B. Basis of Design for CMU Application:
- 1. Vinyl Graphics Film: 3M™ "IJ180Cv3-10 Controltac™ Graphic Film" cast vinyl film suitable for inkjet printing. Calendered films are not acceptable.
    - a. Film Thickness: 0.05 mm (2 mil, 0.002 inch)
    - b. Surface: Smooth, white, opaque and glossy.
    - c. Applied shrinkage: < 0.1 mm per FTM 14.
    - d. Adhesive: Factory-applied 3M "Comply™ v3" solvent acrylic pressure-sensitive repositionable adhesive with air release channels, protected by double-sided polyethylene coated paper, for dry application only, for permanent, non-removable installation.
      - 1) Adhesion: Approximately 18 N/25 mm per FTM 1 (180 degree peel, glass, 24h, 23 degrees C, 50 percent RH)
  - 2. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
    - a. Curing: Heat and infrared cured
    - b. VOCs: Less than 294 g/L
    - c. Hazardous Air Pollutants (HAPs): None.
    - d. Hazard Warning Labels: None (cautionary only; no "R" phrases).
    - e. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C
  - 3. Protective Laminating Film: 3M™ "Envision™ Luster Wrap Overlamine 8548L" cast film. Calendered films are not acceptable.
    - a. Luster high performance non-PVC film
    - b. Exceptional conformability and lifting resistance
    - c. Less prone to scratching
    - d. Superior UV and acid dew protection
    - e. Longer term vertical durability
    - f. Horizontal warranty

## 2.4 PROCESSING AND PRODUCTION

- A. Lay out each mural image in full-height vertical panels without horizontal seams. Allow overlap at vertical seams for accurate alignment and trimming. Unless otherwise specifically authorized by the Architect, lay out so panels are equal in width and arranged symmetrically. In no case shall a panel be less than one-half the vinyl media width.
- B. For uniform appearance, produce all panels using vinyl film media, inks, and laminating film that are each sourced from a single manufacturing lot or production run.
- C. Each panel shall be free from skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint as many panels as necessary for flawless appearance and consistent color match between all panels.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. With the installer, examine the conditions affecting work of this section, including but not necessarily limited to substrate surface smoothness, cleanliness, and uniformity; adjacent materials; and temperature and humidity.
  - 1. Confirm that substrate surfaces are properly finished, smooth, and clean, and are free of contaminants, texture, roughness, voids, protrusions and other surface irregularities that could impair adhesion or telegraph through the applied film.
  - 2. Report unsatisfactory conditions to the Architect in writing.
  - 3. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of installation shall be deemed to be acceptance of conditions as satisfactory.

#### **3.2 PREPARATION**

- A. Acclimatize printed vinyl film and other materials to the environment where they will be installed for at least 24 hours prior to commencement of installation, or for a longer period if recommended by the manufacturer.
- B. Prior to installation, re-inspect mural panels closely for skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint and replace as many panels as necessary for flawless appearance and consistent color match between all panels.

#### **3.3 INSTALLATION**

- A. Digitally-Printed Vinyl Murals:
  - 1. Installation shall be performed only by trained, experienced personnel approved by the graphics provider.
  - 2. Install in accordance with manufacturer's instructions and reviewed submittals.
  - 3. Install in location(s) shown on drawings
  - 4. Seams: Hairline, with overlapped, razor-cut butt joints. Visually align adjacent panels for accurate registration with no visible gaps, offsets or misalignments.
  - 5. Install without bubbles, wrinkles, gaps, fish mouths and other surface and seam irregularities for a smooth, uniform appearance.

#### **3.4 CLEANING AND PROTECTION**

- A. Protect installed work from deterioration and other damage as recommended by the manufacturer until date of Substantial Completion.
- B. If necessary and possible, clean or repair murals to restore to like-new condition following manufacturer's written instructions and recommendations.
- C. Replace materials found to be defective or damaged, if it is not possible to clean or restore them to like-new condition.
- D. Clean and repair damaged adjacent surfaces and other work damaged by the work of this section. If damage cannot be cleaned or repaired to the equivalent of new condition (or for existing materials, their condition prior to damage from construction), replace damaged materials with new undamaged materials.

**END OF SECTION 12 11 00**

## **SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Horizontal slat louver blinds.
  - 2. Operating hardware.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
  - 2. Section 10 71 13 - Exterior Sun Control Devices: Exterior horizontal louver blinds.

#### **1.3 REFERENCE STANDARDS**

- A. NFPA 1 - Fire Code; 2024.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the placement of concealed blocking to support blinds. Refer to Section 06 10 00 - Rough Carpentry.

#### **1.5 SUBMITTALS**

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data indicating [physical and dimensional characteristics; operating features.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 6-inch long illustrating slat materials and finish, wand; and type and color.
- E. Manufacturer's Installation Instructions: Indicate [special procedures; perimeter conditions requiring special attention.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
  - 2. Extra Blind Assemblies: One of each size.
  - 3. Extra Slats: 20 of each type and size.
  - 4. Extra Lift Wands: One of each type.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

1. Horizontal Louver Blinds:
  - a. Hunter Douglas Architectural: [www.hunterdouglasarchitectural.com](http://www.hunterdouglasarchitectural.com).
  - b. Levolor: [www.levolor.com/commercial](http://www.levolor.com/commercial).
  - c. Springs Window Fashions (SWF) contract, a division of Springs Window Fashions, LLC: [www.swfcontract.com](http://www.swfcontract.com).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
  1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- C. Source Limitations: Furnish blinds and associated controls produced by a single manufacturer and obtained from a single supplier.

## 2.2 BLINDS WITHOUT SIDE GUIDES

- A. Basis of Design:
  1. Classics 1" Cordless Aluminum Blinds manufactured by SWFcontract.
- B. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail complying with WCMA A100.1.
- C. Manual Operation: Control of raising and lowering by cordless mechanism; blade angle adjustable by control wand.
- D. Metal Slats: Spring tempered pre-finished aluminum manufacturing burrs removed.
  1. Width: 1 inch.
  2. Minimum Thickness: 0.006 inch.
  3. Color: As selected by the Architect.
- E. Slat Support: ladder configuration.
- F. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
  1. Height: As required.
  2. Color: Match slats.
- G. Bottom Rail: Pre-finished, formed aluminum with end caps.
  1. Color: As selected by the Architect.
- H. Lift Cord: Braided Polyester Yarn continuous loop; complying with WCMA A100.1.
  1. Free end looped through wall-mounted spring-tensioned [weighted; looped through wall mounted spring tensioned pulley.
  2. Color: As selected by the Architect.
- I. Control Wand: Polycarbonate hexagonal shape.
  1. Removable type.
  2. Length of window opening height less 3inch.
  3. Color: Clear.
- J. Headrail Attachment: Ceiling brackets.
- K. Accessory Hardware: Type recommended by blind manufacturer.

## 2.3 FABRICATION

- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1/8 inch.
- C. Fabricate blinds to cover window frames completely.
- D. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch between blinds located at window mullion centers.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed. Refer to Section 06 10 00 - Rough Carpentry.

**3.2 INSTALLATION**

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk; concealed fasteners.
- C. Place intermediate head supports at spacing recommended by the manufacturer.

**3.3 TOLERANCES**

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
- B. Maximum Offset from Level: 1/8 inch.

**3.4 ADJUSTING**

- A. Adjust blinds for smooth operation.
- B. Motorized Blinds:
  - 1. Set limit switches for uniform range of motion according to project requirements.
  - 2. Program control system parameters according to requirements of the Owner.

**3.5 CLEANING**

- A. Clean blind surfaces just prior to occupancy.
- B. Refer to Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

**END OF SECTION 12 21 13**

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## **SECTION 12 35 50 - EDUCATIONAL CASEWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Manufactured plastic laminated casework, hardware and related accessories.
- B. Library shelving.

#### **1.3 REFERENCES**

- A. American National Standards Institute:
  - 1. ANSI A156.9 - Cabinet Hardware.
  - 2. ANSI A161.1 - Woodwork Testing Standards
- B. Architectural Woodwork Institute:
  - 1. AWI - Quality Standards Illustrated.
- C. National Electrical Manufacturers Association:
  - 1. NEMA LD 3 - High Pressure Decorative Laminates.
- D. Composite Panel Association
  - 1. Technical Bulletin - MDF for Shelving

#### **1.4 DEFINITIONS**

- A. Identification of casework components and related products by surface visibility.
  - 1. Balanced construction: High pressure laminate or cabinet liner shall be installed on both sides of core to restrict warpage in accordance with AWI Quality Standards Illustrated Section 400B-T-2.
  - 2. Open Interiors: Open unit without solid door and drawer fronts, and units with full glass insert or acrylic doors.
  - 3. Closed Interiors: Closed unit behind solid door, drawer fronts, and sliding solid doors.
  - 4. Exposed Ends: Exterior side surface that is visible after installation.
  - 5. Other Exposed Surfaces: Faces of doors and drawers when closed and tops of cabinets less than 72 inches above finished floor.
  - 6. Semi-Exposed Surfaces: Interior surfaces which are visible, bottoms of wall cabinets and tops of cabinets 72 inches or more above finished floor.
  - 7. Concealed Surfaces: Any surface not visible after installation.
- B. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with AWI "Quality Standards Illustrated", Custom Grade, except where specification exceeds those standards, the more stringent shall govern.
- B. Submit certified product test data in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:
  - 1. Base cabinet construction/racking test: 800 lbs.
  - 2. Cabinet front joint loading test: 425 lbs.
  - 3. Wall cabinet static load test: 2,000 lbs.
  - 4. Drawer front joint loading test: 600 lbs.
  - 5. Drawer construction/static load test: 750 lbs.
  - 6. Cabinet adjustable shelf support device/static load test: 300 lbs.
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

## 1.6 SUBMITTALS

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's preprinted product information for all hardware proposed on the project.
  - 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
  - 1. Indicate size, material and finish.
  - 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.
- C. Test Data: Certified product test data in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the areas of product performance, as described below.
- D. Certification: Provide AWI Quality Certification Program certification for casework fabrication indicating manufacturer's registration with AWI Quality Certification Program.
- E. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified core with grade stamp for use as verification of installed product.
- F. Full size mock-up is required for every project.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer: Minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.
- B. Manufacturer: Products certified as meeting or exceeding ANSI-A 161.1 testing standards.

- C. Delivery conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect's discretion, a representative of the Architect may be present at the time of delivery. Casework not conforming to the specified requirements, as reasonably determined by the Architect's representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Section 01 31 00 - Notification of Architect Requirements.

## **1.9 PRODUCT HANDLING**

- A. Deliver completed laminate clad casework, countertops and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

## **1.10 JOB CONDITIONS**

- A. Environmental Requirements: Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
  - 1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
  - 2. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

## **1.11 COORDINATION**

- A. Coordinate the Work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

## **1.12 WARRANTY**

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to the following:
  - 1. Rough or difficult operation, or loose or missing parts.
  - 2. Delamination of surfaces.
  - 3. Noticeable deterioration of finish.
  - 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

## **PART 2 - PRODUCTS**

### **2.1 CASEWORK MANUFACTURERS**

- A. Catalog numbers shown on drawings are based on Architectural Woodwork Standards. They are shown for reference only to indicated component requirements only. Fabrication of units shall be in accordance with these designations.
- B. Manufacturers listed below are certified by AWI Quality Certification Program and are listed for the Contractor's convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project.
  - 1. Casework:
    - a. Calmar Manufacturing Co., Inc., Calmar, IA (563)562-3261
    - b. Case Systems, Inc., Midland, MI (989) 496-9510
    - c. Global Casework Manufacturing, Inc., Sugar Land, TX; (281) 494-6181
    - d. Jericho Woodworks, Sugarland, TX; (281) 313-5780
    - e. MGC Millwork, LP, Stafford, TX (281) 340-1400
    - f. Robert Shaw Mfg. Co., Inc., Fort Worth, TX (817) 927-2557
    - g. Stevens Industries, Inc. Teutopolis, IL (217) 540-3100
    - h. Terrill Manufacturing Co., San Angelo, TX; (915) 655-7133
    - i. TMI Systems Design Corp., Dickenson, ND; (701) 225-6716

## 2.2 MATERIALS

- A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
  - 1. Exterior Color Selection Available:
    - a. Architect to select from minimum of 250 selections available, including wood grain patterns and solid colors.
    - b. Provide 5 different colors available per project.
    - c. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
  - 2. Laminate grades:
    - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
    - b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
    - c. Cabinet Liner: CL20 (0.020 inch nominal), white.
    - d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
    - e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.
  - 3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
  - 4. Chemical Resistant Cabinet Surfacing: (all locations of Science Labs and Prep Rooms) Provide WilsonArt Chemsurf or comparable product at all exterior cabinet faces and exposed end panels and shall be used at all Science Labs and Prep Rooms.
  - 5. Pressure Fused Laminate:
    - a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
    - b. Color:
      - 1) Closed interiors, underside of wall cabinets: White.
      - 2) Exposed and Semi-exposed open cabinets: Match exterior.
    - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.

- B. Core Material:
1. UltraStock MDF
  2. Plywood: Exterior grade, hardwood faced, any species, with no defects affecting strength or utility. Face: Grade B, Back: Grade 2, Core: Grade K 3/8", Base: treated wood only. Overlay plywood not permitted.
  3. Cabinet components shall be of the following minimum core thicknesses:
    - a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch UltraStock MDF
    - b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch UltraStock MDF.
    - c. Work surfaces, back splash, and countertops: Plywood, 3/4" Birch 7 ply, use marine grade plywood, 3/4" Birch 7 ply within 4' of center of sinks and wet areas.
    - d. Shelves: 3/4 inch UltraStock MDF core for 30 inches long or less, 1 inch thick UltraStock MDF core for more than 30 inches long; 14" deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
    - e. Cabinet Toe-Base: Treated plywood, 3/4" Birch 7 ply over; Preservative treated 2x solid lumber. No MDF within four (4) inches of floor.
- C. Countertops and Backsplashes:
1. Countertops: Provide countertops with PVC edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
  2. Backsplash: 4 inch high unless otherwise shown. No joint shall occur at sink openings. Provide backsplash set in full bead of sealant.
  3. At exposed countertop end corners, provide 1 inch radius half bullnose, or similar safety treatment.
- D. Sinks: Refer to Division 22. Sizes as shown on drawings. Provide sealant at sink cut-outs.
- E. Service Fixtures: Refer to Division 22.
- F. Toe Spaces: Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- G. End Panels and Filler Strips: Match adjacent case-piece.
- H. Edging:
1. Provide the following in accordance with "Edging Locations":
    - a. Flat Edge PVC: 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
    - b. 3 mm PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.
  2. Edging Locations:
    - a. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
    - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
    - c. Door/Drawer-Front edging: 3mm PVC, color matched to standard laminates.

- I. Shelving:
  1. All vertical uprights of library shelving shall be a minimum of 1" thick, 9 ply hardwood lumber core veneer panels. All exposed edges to be banded with oak edge bands.
  2. The 2" canopy cornice shall be constructed of an oak plywood top with a solid oak bullnose fascia strip which is machine applied to the front edge. Bolting cleats are attached by means of wood screws and glued construction.
  3. Continuous top shelving shall have a 2" deep dovetailed top frame provided with countersunk holes for screwing down a continuous top made of solid core with standard flush bullnose 3/4" thick solid oak edge bands or as specified in the equipment list. Bases shall be of solid hardwood 3-1/2" in height with dovetail joints.
  4. Shelving units shall be standard with back panels on single faced shelving and divider panels on double faced units. Backs shall be recessed in a dado on all sides. Double Face Units 60" and higher without back shall receive a metal angled support bracket. End panels shall be joined to cornice and base by means of metal ferrules embedded in the Backs shall be 1/4" thick 3-ply structural core with oak veneer facing and finished on one side for single faced units and both sides for double faced units. end panels with 5/16" hex head bolts passing through the cleats on the cornice and the sides of the base and engaging the ferrules. Filler and corner units shall be supplied as needed to complete shelving runs as shown on the plan.
  5. Shelves shall be a minimum of 3/4" thick, edge glued, solid oak strips no less than 1-1/2" wide nor more than 4" wide. The underside of all shelves shall be neatly routed to receive the metal supporting pins. Adjustment of shelves shall be of pin hole style construction with adjustments at 1-1/4" increments, which provides for a cleaner less conspicuous installation.
  6. Adder shelving units shall be joined by means of 5/16" hex head bolts passing through both bases and the intermediate upright, both cleats on the cornices and the intermediate upright, and then secured with washers and nuts.
  7. All shelving 60" high and under can have a continuous style top with high pressure plastic laminate surface. *Continuous tops when used, shall have the standard 3/4" x 1-1/4" external bullnose solid oak edge band or an optional edge style as specified in the equipment schedule.* All shelving 72" and higher will have a 2" wood veneer canopy top to match shelving unit.
8. Shelf arrangements per face shall be as follows:

Height	Number of Shelves	Metal Shelf Option	Wood Shelf Option
60"		5	5
84"		6	7

**2.3 CABINET HARDWARE**

- A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
  1. Acceptable Manufacturers:
    - a. Accuride
    - b. Ives

- c. Knappe & Vogt
  - d. National
  - e. Stanley
- B. Hinges:
- 1. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.
  - 2. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
  - 3. Finish: US26D.
- C. Pulls:
- 1. Wire design, 4 inches, Chrome, US26D finish.
- D. Sliding Door Hardware:
- 1. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
  - 2. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
- 1. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
  - 2. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
  - 3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
  - 4. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.
- F. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
- 1. Provide top-mounted magnetic catch for base and wall cabinet door.
  - 2. Provide two at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:
- 1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
  - 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
  - 3. Load rating shall be minimum 300 pounds each support without failure.
- H. Wardrobe Rod: 1 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.
- J. Locks: Provide the following:
- 1. Cabinet Locks – National Model No. C8053 disc tumbler cam lock, keyed removable cores are not allowed, core removal shall be performed by removal

tool and not core key. Cylinder face and keys to be engraved with matching numbers. Cabinet locks in each room are to be keyed alike. Locks are to be master keyed to E41A. Provide two (2) keys per lock. Provide sample of cabinet lock for approval by CFISD lockshop.

2. Clinic Locks – CCL cam lock Model No. B15760-US26D keyed to AUE39. Stamp AUE39 on cam lock face. Provide two (2) keys per room.
3. Approved Manufacturer – National, no substitutions.

## 2.4 SPECIALTY ITEMS

- A. Grommets:
  1. Size: 2-1/2 inches diameter with “Flip-Top”™ tab in cap.
  2. Colors: As selected by Architect from manufacturer’s available colors.
  3. Number/Location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
  4. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc., Manhattan Beach, CA; (800) 523-1269, or comparable product.
- B. Keyboard Drawers:
  1. Approved Product/Manufacturer: No. SD-1 as manufactured by Knape & Vogt; or comparable product.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide where indicated on plans.
- D. Hanging File Rails to be provided at all File Drawers.

## 2.5 FABRICATION

- A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.
- B. Detailed Requirements For Cabinet Construction:
  1. Toe-Base:
    - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor
    - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
    - c. No cabinet sides-to-floor will be allowed.
  2. Cabinet Top and Bottom:
    - a. Solid sub-top shall be furnished for all base and tall cabinets.
    - b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
    - c. Assembly devices shall be concealed on bottom side of wall cabinets.
  3. Cabinet Sides:
    - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
    - b. Drill holes for adjustable shelves 1-1/4 inches on center.



4. Cabinet Backs:
  - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
  - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
  - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.
5. Exposed end corner and face frame attachment:
  - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
  - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
  - b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
  - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- C. Drawers:
  1. Drawer fronts: apply to separate drawer body component sub-front.
  2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
  3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
  4. Paper storage drawers: fitted with full width hood at back.
  5. File Drawers: inside drawer dimensions to accommodate letter and/or legal size hanging file rails.
- D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- F. ADA, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA", or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
  1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
  2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
  3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
  4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.
  5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than

11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
- B. Verify that casework and equipment may be installed in accordance with the original design, pertinent codes, and regulations, and approved shop drawings.
- C. Verify casework and equipment requiring power or other utilities, have power and other utilities ready for their installation.
- D. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until such discrepancies have been resolved.

#### **3.2 INSTALLATION**

- A. Items of casework shall be uncrated, placed in proper location, assembled, leveled, and secured to wall, base or floor, when required, at locations indicated on the Architect's drawings. Apply and adjust hardware.
- B. Plumbing and electrical items not specified in this Section shall be furnished under Division 22 and 26. The casework supplier shall be responsible for all cutouts necessary to receive plumbing items. Provide 'J' clamps to secure sinks to countertops.
- C. Installation of work furnished by the various trades shall be coordinated to assure properly functioning equipment at the completion of the job.
- D. Verify lengths of countertops, splashes, and bases. All units with exposed backs, interiors, ends and/or bases shall be plastic clad with colors as selected by Architect.
- E. Provide backsplashes and end splashes wherever a back or end is next to a wall, where shown or not.
- F. Provide matching fillers and scribes to fit cabinets to partitions, equipment, and columns.
- G. Provide closure panels at top and bottom of wall hung cabinets at corner intersections.
- H. Repair or remove and replace defective work as directed on completion of installation.
- I. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- J. Provide necessary protective measures of finished work to prevent damage of casework and equipment from exposure to other construction activity.

**END OF SECTION 12 35 50**

## **SECTION 12 35 53.19 - LABORATORY CASEWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Wood casework.
- B. Epoxy resin work surfaces.
- C. Service fittings.
- D. Accessory items as specified herein.

#### **1.3 RELATED SECTIONS**

- A. Section 06 10 00 - Rough Carpentry: Blocking within walls to adequately support casework.
- B. Section 08 71 00 - Finish Hardware: Refer for Owner's keying system for locks.
- C. Section 09 65 19 - Resilient Tile Flooring and Base: Furnishing and installing rubber base.
- D. Section 12 35 50 - Educational Casework
- E. Division 22 - Mechanical:
  - 1. Furnishing and installation of piping, drainline, traps, final connections and setting of sinks and fixtures.
  - 2. Furnishing and installation of exhaust ductwork, transition(s), blowers and equipment, and final connection to fume hood(s).
- F. Division 26 - Electrical: Furnishing and installation of electrical wiring, conduit and/or electrical items and final connections.

#### **1.3 REFERENCES**

- A. American Disabilities Act (ADA)
  - 1. American Disabilities Act Design Guidelines (ADADG).
  - 2. 2012 Texas Accessibility Standards (TAS).
- B. American National Standards Institute (ANSI)
  - 1. American National Standards Publications.
- C. American Woodwork Institute
  - 1. Architectural Woodwork Quality Standards.
- D. SEFA (Scientific Equipment and Furniture Association) standards.
  - 1. SEFA 1.2 – Fume Hoods.
  - 2. SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment.

3. SEFA 3 – Work Surface.
4. SEFA 7 – Laboratory and Hospital Fixtures.
5. SEFA 8 – Laboratory Furniture.

#### 1.4 DEFINITIONS

- A. Definitions of cabinet components by surface visibility:
1. Exposed Surfaces:
    - a. Surfaces visible when drawers and solid doors are closed.
    - b. Surfaces visible behind clear glass doors.
    - c. Interior surfaces of open units.
    - d. Bottoms of cabinets 42 inches or more above finished floor.
    - e. Tops of cabinets less than 78 inches above finished floor, or are visible from an upper floor or staircase after installation.
    - f. Front edges of cabinet body members visible though a gap greater than 1/8 inch with doors and drawers closed.
    - g. Surfaces visible when fixed appliances are installed.
  2. Semi-exposed Surfaces:
    - a. Surfaces visible when doors are open.
    - b. Bottoms of cabinets 30 inches - 42 inches above finished floor.
    - c. All front edges of shelving behind doors.
  3. Concealed Surfaces:
    - a. Surfaces not normally visible after installation.
    - b. Bottoms of cabinets less than 30 inches above finished floor.
    - c. Tops of cabinets over 78 inches above finished floor which are not visible from an upper level.
    - d. Stretchers, blocking, components concealed by drawers.

#### 1.5 SUBMITTALS

- A. Manufacturer's Compliance Statement:
1. Pre-qualified manufacturers whose name appears below under acceptable Manufacturers shall provide statement of compliance as scheduled by General Contractor; or
  2. Manufacturers requesting substitution of products shall submit statement of compliance at proposal time in accordance with Division 1 requirements for substitutions.
- B. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components.
- C. Product Data: Submit manufacturer's catalog for reference. Include cabinet dimensions, configurations, construction details, joint details, attachment details, and rough-in details as required.
- D. Product Samples to be submitted for approval (One (1) each):
1. Worktop: Four (4) inch x four (4) inch sample of each material.
  2. Finish: Three (3) inch x five (5) inch sample of each available standard stain color with finish for Architect's selection.
  3. Provide an actual sample of a cabinet in the color and finish selected for Architect's approval. Approved cabinet color and finish will be basis for which all work will be judged. Approved sample cabinet may be used in the work. All cabinets shall match in

color and finish to that of the approved sample and if found to vary in color, i.e., too light or too dark shall be refinished to match approved sample at no expense to Owner.

4. Hardware: Pulls, locks and hinges. Locks shall be keyed alike and masterkeyed to Owner's keying system as specified in Section 08 71 00.

## **1.6 QUALITY ASSURANCE**

- A. Single source: Casework and fume hoods to be manufactured and furnished by a single laboratory furniture company.
- B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:
  1. Minimum of ten (10) years experience in manufacture of wood laboratory casework and fume hoods.
  2. Ten (10) installations of equal or larger size.
- C. Installer qualifications: Certified by the manufacturer.
- D. Manufacturer to provide load test results certified by an independent testing laboratory for drawers, doors, suspension slides and unit shelving.
- E. Casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the Owner's request, independent, third part testing must be submitted validating compliance and adheres to the architectural specifications.

## **1.7 PROJECT CONDITIONS**

- A. Do not deliver or install wood product until the following conditions are met:
  1. Windows and doors are installed and the building is secure and weathertight.
  2. Ceiling, overhead ductwork and lighting are installed.
  3. All painting is completed and floor tile is installed.
  4. Interior building temperature to be between 65 degrees F and 80 degrees F, and ambient relative humidity maintained between 25 percent and 55 percent prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, shall be avoided to prevent damage to materials.
- B. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entryways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a manner to permit it to be moved through properly into place.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- A. Delivery: Schedule delivery so rooms are sufficiently complete that material can be installed immediately following delivery.
- B. Casework: Protect finished surfaces from soiling or damage during handling and installation.
- C. Work surfaces: Protect throughout the construction period.

## **1.9 WARRANTY**

- A. Warrant casework against becoming unserviceable or causing an objectionable appearance resulting from defects in materials and workmanship, including workmanship of installation. Materials provided by Casework Manufacturer shall carry a warranty for five (5) years from date of Substantial Completion. Other materials and equipment shall carry warranty by the product manufacturer.
- B. Defects shall include, but not limited to:
  - 1. Discoloration of finish.
  - 2. Missing or loose parts.
  - 3. Noisy or hard operation of moving parts.
  - 4. Failure to meet specifications.

## **PART 2 - PRODUCTS**

### **2.1 APPROVED PRODUCT/MANUFACTURERS**

- A. Design, materials, construction and finish of casework as specified represents the minimum acceptable standard of quality for wood laboratory casework.
- B. Basis of Design Manufacturer: Sheldon Laboratory Systems, Crystal Springs, MS, (601) 892-2731. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
  - 1. Calmar Manufacturing Co., Inc., Calmar, IA (563)562-3261
  - 2. Case Systems, Inc., Midland, MI (989) 496-9510
  - 3. Global Casework Manufacturing, Inc., Sugar Land, TX; (281) 494-6181
  - 4. Jericho Woodworks, Sugarland, TX; (281) 313-5780
  - 5. MGC Millwork, LP, Stafford, TX (281) 340-1400
  - 6. Robert Shaw Mfg. Co., Inc., Fort Worth, TX (817) 927-2557
  - 7. Stevens Industries, Inc. Teutopolis, IL (217) 540-3100
  - 8. Terrill Manufacturing Co., San Angelo, TX; (915) 655-7133
  - 9. TMI Systems Design Corp., Dickenson, ND; (701) 225-6716

### **2.2 CASEWORK DESIGN**

- A. Door and Drawer Design:
  - 1. Lipped Overlay: Partial overlay design with 3/8 inch reveals between door or drawer and frame, door to door, door to drawer, drawer to drawer; 7/16 inch vertical reveal between doors/drawers and cabinet ends.
- B. Standard grain pattern on end panels is vertical.
- C. Grain pattern on cabinet fronts:
  - 1. Combination Grain: Horizontal grain on drawer fronts, vertical grain on door fronts.
- D. Cabinet end panels exposed to view after installation shall be specified as a "finished end" panel. All end panels not exposed to view after installation shall be as listed under "unexposed" plywood.
- E. Cabinets to be rigid, self-supporting design for use in assembly or as single, interchangeable stand-alone units.
- F. Flush Interiors: Surface mounted bottoms and offsets caused by front face frames which interfere

with ease of cleaning are not acceptable.

- G. Joinery: 32mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8mm.
- H. Where shown or required, provide products conforming to ADADG for barrier-free design.

## 2.3 CASEWORK MATERIALS

- A. Hardwood:
  - 1. Lumber core shall conform to ANSI/HPVA HP-1 product standards.
  - 2. Hardwood lumber, clean and free of defects. All lumber kiln-dried to uniform moisture content of six (6) percent.
    - a. Exposed material: Red Oak, Grade I minimum.
    - b. Semi-exposed material: Select hardwood.
    - c. Unexposed material: Sound hardwood of species suitable for the intended purpose.
- B. Plywood:
  - 1. Hardwood plywoods shall conform to ANSI/HPVA HP-1 product standards.
  - 2. Core: 7-ply (3/4 inch thick) and 9-ply (one (1) inch thick) veneer core plywood with cross and face plies bonded with Type II water-resistant glue; drawers are 9-ply, 1/2 inch thick.
  - 3. Face veneer:
    - a. Exposed surfaces: Plain-sliced red oak veneer, grade A, selected for golden wheat color and narrow hearts.
    - b. Semi-exposed: Same species as specified for exposed face veneer, grade 2 for oak.
    - c. Unexposed: Same species as specified for exposed and semi-exposed veneer, grade at option of manufacturer.
- C. Welded fiberboard: Tempered welded fiber shall be wood fibers and natural resin binding agent compressed into dense homogeneous sheets. Sheets are impregnated with a special tempering compound polymerized by baking to give exceptional strength, and shall conform to ANSI/AHA A135.4 Basic Hardboard for Class 1 tempered grade.
- D. Glue: Laminating - Type II water-resistant; assembly - Type III water-resistant.
- E. Edgebanding: 3mm hardwood of same species as exposed face veneers.
- F. Finish: Highly chemical-resistant modified acrylic urethane finish with built in U.V. blocker or equal finish applied over stain of selected color. Finish shall meet performance characteristics of TR-5, Section 1500, AWI Architectural Woodwork Quality Standards (latest edition).

## 2.4 CASEWORK FABRICATION

- A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.
- B. Detailed Requirements For Cabinet Construction:
  - 1. Toe-Base:
    - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor

- b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
    - c. No cabinet sides-to-floor will be allowed.
  2. Cabinet Top and Bottom:
    - a. Solid sub-top shall be furnished for all base and tall cabinets.
    - b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
    - c. Assembly devices shall be concealed on bottom side of wall cabinets.
  3. Cabinet Sides:
    - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
    - b. Drill holes for adjustable shelves 1-1/4 inches on center.
  4. Cabinet Backs:
    - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
    - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
    - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.
  1. Exposed end corner and face frame attachment:
    - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
  2. Door and Drawer Fronts:
    - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
    - b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
    - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- C. Drawers:
  1. Drawer fronts: apply to separate drawer body component sub-front.
  2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
  3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
  4. Paper storage drawers: fitted with full width hood at back.
  5. File Drawers: inside drawer dimensions to accommodate letter and/or legal size hanging file rails.
- D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.



- E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- F. ADA, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA", or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
  - 1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
  - 2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
  - 3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
  - 4. FSink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

## 2.5 CABINET HARDWARE

- A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
  - 1. Acceptable Manufacturers:
    - a. Accuride
    - b. Ives
    - c. Knappe & Vogt
    - d. National
    - e. Stanley
- B. Hinges:
  - 1. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.
  - 2. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
  - 3. Finish: US26D.
- C. Pulls:
  - 2. Wire design, 4 inches, Chrome, US26D finish.
- D. Sliding Door Hardware:
  - 2. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
  - 3. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
  - 2. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.

3. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
  4. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
  5. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.
- F. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
1. Provide top-mounted magnetic catch for base and wall cabinet door.
  2. Provide two at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:
1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
  2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
  3. Load rating shall be minimum 300 pounds each support without failure.
- H. Wardrobe Rod: 1 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.
- J. Locks: Provide the following:
1. Cabinet Locks – National Model No. C8053 disc tumbler cam lock, keyed removable cores are not allowed, core removal shall be performed by removal tool and not core key. Cylinder face and keys to be engraved with matching numbers. Cabinet locks in each room are to be keyed alike. Locks are to be master keyed to E41A. Provide three (3) keys per lock. Provide sample of cabinet lock for approval by CFISD lockshop.
  2. Clinic Locks – CCL cam lock Model No. B15760-US26D keyed to AUE39. Stamp AUE39 on cam lock face. Provide two (2) keys per room.
  3. Approved Manufacturer – National, no substitutions.
  4. Provide three (3) master keys (E41A), provide five (5) locks of each type used for Owner stock. All casework keys shall be turned over to the CFISD Maintenance Department, not given to the school.

## 2.6 MECHANICAL SERVICE FITTINGS

- A. Manufacturer: Chicago Faucet Co., vandal resistant.
- B. Laboratory Service Fittings:
1. Service fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All fittings shall be chromium plated unless specified otherwise.
- C. Water Fittings:
1. Water fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral volume control device and all faucets shall be capable of being readily converted from compression to self-

closing, without disturbing the faucet body proper. Four (4) arm forge brass handles shall contain plastic screw-on type colored service index buttons.

- D. Ground Key Valve Hose Cocks:
  - 1. Ground key type valves shall have forged body with 10 serration hose end. Handle plug shall be forged brass, long, tapered type with screw-on colored service index button. Valves shall be individually ground, lapped and sealed.
- E. Needle Valve Hose Cocks:
  - 1. Needle type valves shall have a stainless steel replaceable floating cone, precision finished and self-centering. Cone locates against a stainless steel seat, easily removable and replaced with a socket wrench. Valve shall have "Teflon" impregnated packing and designed so unit can be repacked while under pressure.
- F. Gooseneck Type Outlets: Gooseneck outlets shall have a separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.
- G. Remote Control Valves: All valves for remote control use shall be as previously specified, but shall be complete with brass extension rods, escutcheon plates, brass forged handles and screw-on type colored service index button.
- H. Tank Nipples: Tank nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.
- I. Service Indexes: Fittings shall be identified with service indexes in the following color coding:
  - Hot Water ..... Red
  - Cold Water ..... Dark Green
  - Gas..... Dark Blue
  - Air ..... Orange
  - Vacuum ..... Yellow
  - Distilled Water ..... White
  - Steam..... Black
  - Nitrogen..... Gray
  - Oxygen..... Light Green
  - Hydrogen..... Pink
  - Special Gases..... Light Blue
- J. Electrical Fittings: Electrical fittings shall contain 20 Amp., 125 Volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.
- K. Sink Outlets: Unless otherwise specified, sink outlets for other than stainless steel sinks shall be Molded Epoxy Resin, with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2 inch I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically called for.
- L. Crumb Cup Strainers: Crumb cup strainers shall be stainless steel or chromium plated brass, as specified and shall be furnished for stainless steel sinks, and be complete with gasket, lock nut and 4 inch long unthreaded tailpiece outlet in 1-1/2 inch size.
- M. Vacuum Breakers: Vacuum breakers when specified to be required, shall be the 'Nidel or Watts'

type unless specified to be an integral part of gooseneck fixture with a renewable seat and fine flow control.

- N. Aerator Outlets: Aerator type outlets shall be furnished for all gooseneck water faucets nor furnished with serrated hose connectors.

## 2.7 WORKSURFACES

- A. Prep Rooms:
  - 1. Epoxy Resin Tops: Factory molded tops of modified epoxy resin formulation, uniform mixture throughout full one (1) inch thickness. Color shall be non-glare black. Cast surfaces shall be very smooth, with factory cutouts for sinks and drip grooves. Plain butt type joints assembled with epoxy adhesive.
- B. Classrooms:
  - 1. Chemical Resistant Plastic Laminate.

## 2.8 LABORATORY TABLE

- A. Basis of Design: Student Lab Table as manufactured by Sheldon Laboratory Systems.
  - 1. Size: 24 inches by 60 inches.
  - 2. Top: Phenolic Tops.
  - 3. Legs: Solid Wood.
  - 4. Type: Moveable.
- B. Demo Stations:
  - 1. Size: Refer to Drawings.
  - 2. Top: Epoxy Resin.
  - 3. Legs: Solid Wood with casters.
  - 4. Type: Moveable.
- C. Demo Stations:
  - 1. Size: Refer to Drawings.
  - 2. Top: Epoxy Resin.
  - 3. Legs: Solid Wood.
  - 4. Type: Fixed.

## 2.9 J-FRAME SUPPORT SYSTEMS

- A. General: The 'J'-frame support structure shall consist of vertical (inverted 'J') support members and horizontal tubular frames.
- B. Vertical 'J' Support Members:
  - 1. Vertical 'J' support members shall be 16 gauge, 1-1/4 inch square Type 304 stainless steel seamless tubing, heliarc welded where required, ground smooth at all joints and given a satin finish.
  - 2. The vertical support members shall be formed into an inverted 'J' maintaining a smooth contour without warp or twist in the metal. Each vertical support shall have a 1 inch height adjustment for handling various floor conditions and be so designed as to maintain a fixed position on the floor. A concealed 'hold-down' angle or other means will be acceptable. Molded vinyl tapered leg shoes shall be furnished at each support leg to conceal the adjustment device and/or 'hold-down' angle. Each support shall have two

5/16 inch - 18 stud bolts supplied for each side for securing the horizontal frames. Cap nuts shall be furnished for all exposed studs.

- C. Horizontal Frames: All horizontal frames shall have a 1-1/4 inch square tubing front and rear members. Horizontal frames shall be 16 gauge, Type 304 stainless steel, heliarc welded throughout ground smooth at all joints and given a satin finish.
- D. "J"-Frame Performance Requirements: The support structure shall be designed for heavy-duty laboratory usage, and when a wall table is completely assembled with work top and cabinets in place, it shall support the following loads:
  - 1. A 7 foot long wall table assembly with 4 foot and 3 foot modular spacing shall support a load of 1,500 lbs. uniformly distributed over the work top area.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Casework installation:
  - 1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
  - 2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16 inch tolerance.
  - 3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by rough carpentry as specified in Section 06 10 00.
  - 4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8 inch between top units.
- B. Work surface installation:
  - 1. Where required due to field conditions, scribe or caulk to abutting surfaces.
  - 2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.
  - 3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
- C. Sink installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations. Sinks to include a 1-1/2 inch raised corner and chamfered edge.
- D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.

#### **3.2 ADJUSTING**

- A. Repair or remove and replace defective work, as directed by Architect upon completion of installation.
- B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

#### **3.3 CLEANING**

- A. Broom clean finished casework, touch up as required.
- B. Clean materials as recommended by manufacturer.

**3.4 PROTECTION OF FINISHED WORK**

- A. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.
- B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

**END OF SECTION 12 35 53**

## **SECTION 12 35 83 - PERFORMING ARTS CASEWORK**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes requirements including but not limited to:
  - 1. Musical Library System.
  - 2. Storage Cabinets.
  - 3. Tuba/Sousaphone Wall Bracket.
  - 4. Accessories necessary for a complete installation.
- B. Related Sections:

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
  - 1. Complete shop drawings for the Architect's approval.
  - 2. Unit layout for Owner's approval.
- C. Samples: Include color charts showing manufacturer's full range of colors for Architect's selection.

#### **1.4 WARRANTY**

- A. Storage - Written warranty in which manufacturer agrees to repair or replace components of installation that fail in materials or workmanship within specified warranty period:
  - 1. Warranty does not include deterioration or failure per due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Warranty Period: Ten (10) years from date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
  - 1. Melhart Music Center.
  - 2. TMI Systems Design Corp.
  - 3. Wenger Corporation (The).
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

#### **2.2 MATERIALS AND MANUFACTURERS**

- A. Music Library System - Standard width 7-shelf unit:
  - 1. Basis of Design: Model 173G700 manufactured by The Wenger Corporation.
  - 2. Overall Dimensions:
    - a. Closed Position: 16 inch wide x 44 inch deep x 92-1/2 inch high.
    - b. Open Position: 16 inch wide x 80 inch deep x 92-1/2 inch high.
  - 3. Pull out design, equally spaced shelves provide 10-1/2 inch of available height per shelf.
  - 4. Frame: 16 gauge, 1 inch square tubular steel, painted black.

5. Accessories: Latch Kit Accessory and provide Master Lock Brand key controlled combination padlocks No. 1525 at each compartment. Provide control chart and backcase identification stamp on each lock.
- B. Storage Cabinets:
1. Basis of Design: UltraStor Storage Cabinets manufactured by The Wenger Corporation.
  2. Wall Panels: 3/4 thick industrial grade composite wood with no added formaldehyde and polyester laminate finish in manufacturer's standard colors.
  3. Shelves: Blow-molded polyethylene mounted with self-lock shelf supports.
  4. Grooved shelves allow air to circulate.
  5. Edging: 1/8 inch radiused PVC.
  6. Door Options: Architect to select.
  7. Cabinets: Five adjustable steel leveling glides for uneven floors.
  8. Doors: Heavy-duty, 5-knuckle institutional ANSI/BHMA A156.9.
  9. Provide Master Lock Brand key controlled combination padlocks No. 1525 at each compartment. Provide control chart and backcase identification stamp on each lock.
- C. Tub/Sousaphone Wall Bracket:
1. Basis of Design: Model #049E100 Tuba/Sousaphone Wall Bracket as manufactured by The Wenger Corporation.
  2. Height: Adjusts from 22-1/2 inch min. to 35 inch max.
  3. Width: Adjusts 13-1/2 inch min. to 22 inch max.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's printed instructions.
- B. Adjust for proper operation.
- C. Installation of four (4) inch rubber base.

**END OF SECTION 12 35 83**



## **SECTION 12 36 00 - COUNTERTOPS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  1. Plastic Laminate Countertops.
  2. Quartz countertops.
  3. Epoxy Resin Countertops.
  4. Solid Surfacing Countertops.
  5. Setting materials and accessories.

#### **1.3 REFERENCES**

- A. American National Standards Institute (ANSI):
  1. A108.5 - Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.
  2. A118.4 - Latex-Portland Cement Mortar.
- B. ASTM International (ASTM):
  1. C97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
  2. C99 - Standard Test Method for Modulus of Rupture of Dimension Stone.
  3. C170 - Standard Test Method for Compressive Strength of Dimension Stone.
  4. C241 - Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
  5. C482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement.
  6. C484 - Standard Test Method for Thermal Shock Resistance of Glazed Ceramic Tile.
  7. C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
  8. C648 - Standard Test Method for Breaking Strength of Ceramic Tile.
  9. C650 - Standard Test Method for Resistance of Ceramic Tile to Chemical Substances.
  10. C672/C672M - Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
  11. C880 - Standard Test Method for Flexural Strength of Dimension Stone.
  12. C1026 - Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling.
  13. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
  14. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Include countertop layout, dimensions, materials, finishes, cutouts, and attachments.
- B. Samples:
  - 1. 3 x 3 inch quartz samples showing available colors.
  - 2. 3 inch long joint sealer samples showing available colors.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator and Installer Qualifications: Minimum 2 years documented experience in work of this Section.
- B. Mockup:
  - 1. Construct countertop mockup, 6 feet wide, full depth, with splash and skirt.
  - 2. Include plumbing fixtures and trim.
  - 3. Locate where directed by the Owner and Architect.
  - 4. Approved mockup may remain as part of the Work.

#### 1.6 WARRANTY

- A. Provide manufacturer's 10 year warranty against defects in materials and workmanship.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Contract Documents are based on products identified as basis of design. All other manufacturer's must meet the requirements of specification and be approved by Architect before Bidding.

#### 2.2 MATERIALS

- A. Quartz Sheet (QRC-1):
  - 1. Basis of Design: Products manufactured by Cambria,
  - 2. Composition: Quartz.
  - 3. Color: Ella.
  - 4. Thickness: 3 cm.
  - 5. Edge: Quarter Round.
  - 6. Radius Corners: 1 1/2 inch.
  - 7. Finish: Polished.
- B. Plastic Laminate (PL): Reception Desk.
  - 1. Basis of Design: Refer to Drawings.
  - 2. Edge: Architect to select from Manufacturer's full range of offerings.
  - 3. Color and Pattern: Architect to select from Manufacturer's full range of offerings.
  - 4. Locations: Refer to Drawings.
- C. Plastic Laminate (PLC-1)
  - 1. Basis of Design: Wilsonart.
  - 2. Edge: Architect to select from Manufacturer's full range of offerings.
  - 3. Color and Pattern: Silicon EV4811-60.
  - 4. Locations: Refer to Drawings.

- D. Chemical Resistant Plastic Laminate (CRP-1)
  - 1. Basis of Design: Wilsonart.
  - 2. Chemicals to resist: Chemsurf.
  - 2. Surface Color: Black 1595-60.
  - 3. Edge: Build-Up.
  - 4. Locations: Refer to Drawings.
  
- E. Natural Quartz – Window Sills/ jamb (QRC2):
  - 1. Basis of Design: Products manufactured by Cambria,
  - 2. Composition: Quartz.
  - 3. Color: Templeton.
  - 4. Edge: To be determined.
  - 5. Finish: Polished.

### **2.3 ACCESSORIES**

- A. Adhesive: Type recommended by manufacturer - only.
  - 1. Latex-Portland Cement Mortar: 272 Premium Floor N' Wall Thin-Set Mortar mixed with 333 Super Flexible Additive by Laticrete International, Inc.
  - 2. Latex-Portland Cement Mortar: 254 Platinum Multipurpose Thin-Set Mortar by Laticrete International, Inc.
  - 3. Latex-Portland Cement Mortar: ANSI A118.4.
  - 4. Joint Sealer:
    - a. Latisil Tile and Stone Sealant by Laticrete International, Inc.
    - b. Color: To be selected from manufacturer's full color range.

### **2.4 FABRICATION**

- A. Cut quartz panels accurately to required shapes and dimensions.
- B. Radius exposed edges.
- C. Corner Radius to be 1-1/2 inch.
- D. Fabricate with hairline joints.
- E. Cut holes for sinks and faucets.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean surfaces to receive countertops; remove loose and foreign matter than could interfere with adhesion.

### **3.2 INSTALLATION**

- A. Install countertops in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Set in thin set mortar bed in accordance with ANSI A 108.5.
- C. Set plumb and level. Align adjacent pieces in same plane.
- D. Install with hairline joints.

- E. Fill joints between countertops and adjacent construction with joint sealer; finish smooth and flush.

### **3.3 INSTALLATION TOLERANCES**

- A. Maximum variation from level and plumb: 1/8 inch in 10 feet, noncumulative.
- B. Maximum variation in plane between adjacent pieces at joint: Plus or minus 1/16 inch.

### **3.4 CLEANING**

- A. Clean countertops in accordance with manufacturer's instructions.

### **3.5 PROTECTION**

- A. Protect installed countertops with non-staining sheet coverings.

**END OF SECTION 12 36 00**

## **SECTION 12 66 13 - TELESCOPING BLEACHERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Electrically operated, wall attached with rear wall column cutouts where applicable, telescoping gym seating systems of multiple-tiered seating rows comprising of seat, deck components, understructure that permits closing without requiring dismantling, into a nested configuration for storing or for moving purposes.

#### **1.3 RELATED SECTIONS**

- A. Division 3, Cast-In-Place Concrete and Division 9, Finishes: Floor and wall finishes sections for adequate floor and wall construction for operation of telescoping gym seats. Flooring shall be level and rear wall plumb within 1/8 inch in 8 feet-0 inches. Maximum bleacher force on the floor, of 25 feet-6 inch section, shall be a static point load of less than 300 psi.
- B. Section 11 66 43 - Scoreboards: Scoreboard controller connections and microphone jacks mounted in first step of bleacher riser boards.
- C. Division 26 - Electrical: Electrical wiring and connections for electrically operated motor system.

#### **1.4 MINIMUM COMPLIANCE STANDARDS**

- A. American with Disabilities Act (ADA)
- B. NFPA Standard 102, Section 4, "Folding and Telescoping Seating", current edition, governs the work except where more restrictive items are specified.
- C. Texas Accessibility Standards (TAS)

#### **1.5 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
  - 2. Manufacturer's installation instructions.
  - 3. Manufacturer's maintenance instructions for instructing and demonstrating the proper maintenance to the Owner.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- C. Samples: Manufacturer's standard color chart or actual samples for selection by Architect.
  - 1. Submit two (2) 18 inch long samples of seat boards.

## 1.6 SPECIAL WARRANTY

- A. Warrant the work specified for ten (10) years against all structural components and five (5) years on all other components.
- B. Defects shall include, but not be limited to, the following:
  - 1. Rough or difficult operation
  - 2. Noisy operation
  - 3. Loose or missing parts

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Specifications are based on Maxam Model MXM26 Series Telescopic Gym Seats manufactured by Hussey Seating Co., North Berwick, ME; (207) 676-2271. Manufacturers listed who produce equivalent products to those specified are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.

### 2.2 BLEACHERS, GENERAL

- A. Primary Bleachers at Gym:
  - 1. Row Spacing: 22, 24, or 26 inches as shown on drawings.
  - 2. Seat Height: 17 or 18 inches as shown on drawings.
  - 3. Rise: 9-5/8 inches from seat to seat.
  - 4. Seat Width: Ten (10) inches minimum.
  - 5. Foot Boards: Full width.
  - 6. Number of Rows: As shown on drawings.
  - 7. Length of each unit: As shown on drawings.
  - 8. Provide aisles with intermediate steps and aisle rails as shown on drawings and required by code.

### 2.3 MATERIALS

- A. Riser, Deck, and Seatboard Material:
  - 1. Seat Board: Molded high density structural polyethylene.
  - 2. Riser: Molded high density structural polyethylene.
  - 3. Aisles and Decks: CD grade 5/8 inches plywood, urethane finished.
- B. Design Features:
  - 1. Liveload: (Of whole bleacher) 100 psf of horizontal projection.
  - 2. Liveload: (Seatboards and platforms) 120 psf
  - 3. Sway Load: Parallel, 24 pounds, per linear foot; perpendicular, ten (10) pounds per linear foot.
  - 4. End Panels: Provide end panels where exposed to view.
  - 5. Rails: Self-storing rail, removable end rails, front railings, rear rails, aisle hand rails, where applicable.
    - a. Hand railings, posts and supports shall be engineered to withstand a concentrated load of 200 lbs. applied at any point and in any direction and a uniform load of 50 lbs. per foot applied in any direction, applied separately.

- b. Guard railings, post and supports shall be engineered to withstand a concentrated load of 200 lbs. applied at any point and in any direction along top rail and a uniform load of 50 lbs. per foot applied horizontally at top rail and a simultaneous uniform load of 100 lbs. per foot applied vertically downward, applied separately.
  6. Wheels: Non-marking, extra wide, heavy duty rubber, self lubricating wheels of size and number to suit the wooden floor surfacing.
  7. Wheel Chair Accessible Area: Provide recoverable spaces and end panels complying with ADA and TAS.
  8. Removable Scorers Table:
    - a. High pressure laminate over plywood core.
    - b. 1 foot-3 inches x 8 feet-0 inch minimum size.
    - c. Folding tubular legs for storage, mounting sockets in bleacher deck.
  9. Coordinate location of scoreboard controller connections and microphone jacks mounted in first step of bleacher riser boards with contractor performing work of Section 11482, Scoreboards.
  10. Delete key locks on front of first step risers.
  11. Finish:504 Burgundy.
- C. Operation:
1. Method: Telescope into a stack.
  2. Operation Type: Manual.
  3. Accessories: Mule Assist to be included.
  4. Partial Opening: Permit one (1) or more rows to open; lock into any position.
  5. Even Spacing: Mechanism designed to hold all spaces evenly. Provide automatic alignment of units when in operational stages.
  6. Allow varying numbers of rows to be telescoped out and used at any given time.

### **PART 3 - EXECUTION**

#### **3.1 SURFACE CONDITIONS**

- A. Examine the areas and conditions under which Work of this Section will be performed.
- B. Verify flooring is level and rear wall is plumb within 1/8 inch in 8 feet-0 inches.
- C. Bring discrepancies and unsatisfactory conditions to the attention of the Architect and do not proceed until such discrepancies and unsatisfactory conditions are corrected.

#### **3.2 INSTALLATION**

- A. Use only experienced factory authorized installers.
- B. Install in accordance with manufacturer's printed instructions.
- C. Adjust for smooth, quiet operation.

**END OF SECTION 12 66 13**

## **SECTION 13 34 19 - METAL BUILDING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes a single-story, single-span, single slope, rigid-frame-type pre-engineered metal building of the nominal length, width, eave height, and roof pitch indicated.
  - 1. Exterior walls are covered with field-assembled wall panels attached to framing members using exposed fasteners. Endwalls are not expandable.
  - 2. Roof system consists of the manufacturer's standard standing-seam insulated roof.
  - 3. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Concrete floor and foundations and installation of anchor bolts are specified in Division 03 Section "Concrete Work."
  - 2. Sealants and caulking are specified in Division 07 Section "Joint Sealers."
  - 3. Finish hardware and provisions for masterkeying are specified in Division 08 Section "Finish Hardware."

#### **1.3 SYSTEM PERFORMANCE REQUIREMENTS**

- A. General: Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.
  - 1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
- B. Design Loads: Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings.
  - 1. Basic design loads include live load, wind load, and seismic load, in addition to the dead load.
- C. Structural Framing and Roof and Siding Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual."
  - 1. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
  - 2. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.
  - 3. Welded Connections: Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.



- D. Building Accessories: Provide metal building system accessories that comply with the following criteria:
  - 1. Hollow Metal Doors and Frames: Comply with the Steel Door Institute's SDI-100 for types, styles, and design requirements and with ANSI A115 for hardware preparation.

#### 1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product data consisting of metal building system manufacturer's product information for building components and accessories.
- C. Shop drawings for metal building structural framing system, roofing and siding panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.
  - 1. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, endwall, and roof framing. Include transverse cross-sections.
  - 2. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.
  - 3. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation including the following:
    - a. Personnel doors: Provide elevations and details of each type of door and frame, including anchors and reinforcement; show location and installation requirements for finish hardware. Provide schedule of doors and frames using the same reference numbers for details and openings as those indicated on the drawings; include complete hardware schedule.
    - b. Overhead Coiling Service Doors: Provide fully dimensioned details of construction, including 1/4-inch scale elevations of door units and not less than 3/4-inch scale details showing door curtain, guides, counterbalance, and method of operation.
    - c. Sheet Metal Accessories: Provide layouts at 1/4-inch scale. Provide details of ventilators, louvers, gutters, downspouts, and other sheet metal accessories at not less than 1-1/2-inch scale showing profiles, methods of joining, and anchorages.
- D. Wiring diagrams from the manufacturer of motor operated overhead service doors detailing power, signal, and control systems differentiating clearly between field-installed and manufacturer-installed wiring.
- E. Samples for initial selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal roofing and siding panels with factory-applied finishes.
- F. Samples for verification purposes of roofing and siding panels. Provide sample panels 12-inch long by actual panel width, in the profile, style, color, and texture indicated. Include clips, battens, fasteners, closures, and other panel accessories.
- G. Installer certificates signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.
- H. TDI Windstorm Requirements: Basic design wind speed requirements for construction in the designated catastrophic areas along Texas Gulf coast.

1. Inland I Zone: Resist 120 mph, 3-second gust.

- I. Professional engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the jurisdiction where Project is located, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

## **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.
- B. Manufacturer's Qualifications: Provide pre-engineered metal buildings manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.
- C. Single-Source Responsibility: Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.
- D. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of the pre-engineered metal building system. Metal building systems having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof for equality is on the proposer.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.
- B. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

## **1.7 WARRANTY**

- A. Roofing and Siding Panel Finish Warranty: Furnish the roofing and siding panel manufacturer's written warranty, covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
  1. Warranty period for factory-applied exterior finishes on wall and roof panels is 20 years after the date of Substantial Completion.
- B. Weathertightness:
  1. The entire roof system including all roof panels, flashings, curbs, interior gutters, etc. shall be warranted by the manufacturer against leaks for a period of 20 years.

2. The warranty shall be issued to the Owner by the Manufacturer at time of entire Project Substantial Completion.
  3. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation.
  4. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system by the manufacturer, including materials and labor, shall be done at no cost to the Owner for duration of warranty period.
- C. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering metal building systems that may be incorporated in the Work include but are not limited to the following:
1. A & S Building Systems, Inc.; (800) 274-2100.
  2. Alliance Steel; (800) 624-1579.
  3. American Buildings Co., a Nucor Company; (281) 380-6161.
  4. American Steel Building Co., Inc.; (800) 511-3670.
  5. Anchor Metal Building Systems.
  6. Behlen Manufacturing Co.; (402) 564-3111.
  7. Bigbee Steel Buildings, Inc.; (256) 383-7322.
  8. Ceco Building Systems, an NRCI Building Systems Company; (800) 474-CECO.
  9. Dean Steel Buildings, Inc., (844) 739-DEAN.
  10. Garco Building Systems, an NRCI Building Systems Company; (800) 941-2291.
  11. Kirby Building Systems, Inc.; (662) 323-8021.
  12. LMB Steel Structures, Inc.
  13. MBCI, an NCI Building Systems company.
  14. Mesco Metal Buildings Corp.
  15. NCI Group, Inc.; (281) 897-7788.
  16. Package Steel Buildings Corp.; (800) 225-7242.
  17. Rigid Global Buildings; (281) 443-9065.
  18. Southern Structures, Inc.
  19. Space Master Buildings.
  20. Star Buildings Division, H. H. Robertson Co.
  21. Varco-Pruden Buildings.

### **2.2 MATERIALS**

- A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A 36 or A 529.
- B. Steel Tubing or Pipe: Comply with ASTM A 500, Grade B, ASTM A 501, or ASTM A 53.
- C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with ASTM A 529, ASTM A 570, or ASTM A 572.
- D. Steel Members Fabricated by Cold Forming: Comply with ASTM A 1011, Grade 50.

- E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 366 or ASTM A 568.
- F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 568 or ASTM A 569.
- G. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 446 with G90 coating complying with ASTM A 525. Grade to suit manufacturer's standards.
- H. Bolts for Structural Framing: Comply with ASTM A 307 or ASTM A 325 as necessary for design loads and connection details.
- I. Thermal Insulation: Glass fiber blanket insulation, complying with ASTM C 991, of 0.5 lb per cu. ft. density, thickness as indicated, with UL flame spread classification of 25 or less, and 2 inch wide continuous vapor-tight edge tabs.
  - 1. Type: ASTM C665, Type 1
  - 2. R-Values (minimum): R-30 for roof. R-19 for walls.
  - 3. Surface Burning Characteristics:
    - a. Flame Spread: 25 or less.
    - b. Smoke Developed: 50 or less.
  - 4. Size/Thickness: 6 inch (R-19) vinyl faced over purlin, plus 8 inch (R-25) unfaced in insulation cavity; unless indicated otherwise on drawings. Vinyl side towards attic/plenum space.
  - 5. Use Gympguard insulation on the Roof/ceiling where no liner panels are specified.
  - 6. Approved Manufacturers/Products:
    - a. CertainTeed Corp. (AcoustaTherm).
    - b. Guardian Fiberglass, Inc.(Thermal Control Batts).
    - c. Johns-Manville (Thermal-SHIELD Thermal Insulation).
    - d. Knauf (Thermal Batt Insulation).
    - e. Owens-Corning (Thermal Batt Insulation).
- J. Vapor Barrier: Vinyl film.
  - 1. Retainer Strips: 26-gage (0.0179-inch) formed galvanized steel retainer clips colored to match the insulation facing.
  - 2. Shall be either a vinyl film (3.2 mil thickness) or vinyl reinforced polyester (VRP) film (3 mil approximate thickness). Vinyl reinforced polyester facing is recommended when air temperatures of 30 degrees F or below are anticipated during shipment or erection.
  - 3. Shall have an Underwriters' Laboratories flame spread rate of 25 or less and a smoke developed rating of 50 or less.
  - 4. Shall have a water vapor transmission value of 1.00 perms for vinyl film facing and 0.02 perms for VRP facing.
  - 5. Color: Shall be white.
  - 6. Width: Shall be 78 inches so as to provide a 3-inch tab projecting beyond each side of the fiberglass blanket.
- K. Paint and Coating Materials: Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.
  - 1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, universal primer, selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-645.
  - 2. Shop Primer for Galvanized Metal Surfaces: Zinc dust-zinc oxide primer selected by the manufacturer for compatibility with substrate. Comply with FS TT-P-641.

## 2.3 STRUCTURAL FRAMING

- A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up "I-beam"-shape or open-web-type frames consisting of tapered or parallel flange beams and tapered columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.
1. Provide length of span and spacing of frames indicated. Slight variations in length of span and frame spacing may be acceptable if necessary to meet manufacturer's standard.
  2. Provide rigid frames at endwalls where indicated.
- B. Primary Endwall Framing: Provide the following primary endwall framing members fabricated for field-bolted assembly:
1. Endwall Columns: Manufacturer's standard shop-painted, built-up factory-welded "I"-shape or cold-formed "C" sections, fabricated from 14-gage (0.0747-inch) steel.
  2. Endwall Beams: Manufacturer's standard shop-painted "C"-shape roll-formed sections fabricated from 16-gage (0.0598-inch) steel.
- C. Secondary Framing: Provide the following secondary framing members:
1. Roof Purlins, Sidewall and Endwall Girts: "C"-or "Z"-shaped sections fabricated from 16 gage (0.0598-inch) shop-painted roll-formed steel. Purlin spacers shall be fabricated from 14-gage (0.0747-inch) cold-formed galvanized steel sections.
  2. Eave Struts: Unequal flange "C"-shaped sections formed to provide adequate backup for both wall and roof panels. Fabricate from 16-gage (0.0598-inch) shop-painted roll-formed steel.
  3. Flange and Sag Bracing: 1-5/8- by 1-5/8 inch angles fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel.
  4. Base or Sill Angles: Fabricate from 14-gage (0.0747-inch) cold-formed galvanized steel sections.
  5. Secondary endwall structural members, except columns and beams, shall be the manufacturer's standard sections fabricated from 14-gage (0.0747-inch) cold-formed galvanized steel.
- D. Wind Bracing: Provide adjustable wind bracing using 1/2 inch diameter threaded steel rods; comply with ASTM A 36 or ASTM A 572, Grade D. Locate interior end bay bracing only where indicated.
- E. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.
- F. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning.
1. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.
  2. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc dust-zinc oxide primer.

## 2.4 ROOF AND WALL PANEL COMPONENTS

- A. Metal Roof Panels:

1. Panel Profile: Two (2) inch high by 3/4 inch wide rib by 16 inch wide, striated concealed fastener panel.
  2. Metal Roof System: Vertical leg, concealed fastener, standing seam, utilizing male and female rib configurations, with factory applied hot-melt mastic in female rib, continuously locked together by an electrically powered mechanical seaming device during installation.
  3. Gauge: Minimum 24 gauge (UL 90 rated)
  4. Substrate: Galvalume® steel sheet, Grade “D” minimum yield of 50,000 PSI.
  5. Clips: Two (2) piece floating clip, 18 gauge base, 24 gauge top, with factory applied mastic, with two (2) fasteners to structural. Comply with FM 1-90 requirements.
  6. Texture: Striations.
  7. Finish: Premium fluorocarbon coating produced with Kynar 500® (20 year warranty) in color selected by Architect from manufacturer's available colors.
  8. Touch-up Paint: ZRC Cold Galvanizing Compound manufactured by ZRC Chemical Products, Quincy, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawrence, MA; or paint complying with military specification MILP-21035A, Type I or II.
  9. Approved Product / Manufacturer **SuperLok®** architectural structural (double-lock) standing seam metal roof system manufactured by MBCI, Houston, TX; (281) 445-8555, or Architect approved equal.
- B. Metal Wall Panels (MWP-1)
1. Panel Profile: One and one quarter (1 ¼”) inch high by 36-inch wide, exposed fastener panel.
  2. Gauge: 24 gauge
  3. Substrate: Galvalume Plus® steel sheet, Grade “D” minimum yield of 50,000 PSI.
  4. Texture: Striations
  5. Finish: Premium fluorocarbon coating produced with Kynar® 500 (20 year warranty) in color selected by Architect from manufacturer’s full range of colors.
- C. Metal Wall/Soffit Panels (MWP-2)
1. Panel Profile: One and one-half (1-1/2) inch high by 12 inch wide, flush face concealed fastener panel.
  2. Gauge: 24 gauge
  3. Substrate: Galvalume Plus® steel sheet, Grade “D” minimum yield of 50,000 PSI.
  4. Texture: Striations
  5. Finish: Premium fluorocarbon coating produced with Kynar® 500 (20 year warranty).
  6. Basis of Design Color: Sherwin Williams’ Fully Purple, Color Number 6983 or comparable product approved by Architect.
  7. Approved product manufacturer: FW 120-2 Metal Wall Panel Manufacturer by MBCI, Houston, TX or Architect approved equal.
- D. Light transmitting panels (SL):
1. Basis of Design: MBCI HW-18DIS, or comparable product approved by Architect.
- E. Metal Liner Wall Panel (MLP-1):
1. Panel Profile: One (1) inch high by 12 inch wide, flush face concealed fastener pane
  2. Gauge: 24 gauge
  3. Substrate: Galvalume Plus® steel sheet, Grade “D” minimum yield of 50,000 PSI.
  4. Texture: Striations
  5. Finish: Premium fluorocarbon coating produced with Kynar® 500 (20 year warranty).
  6. Color: Architect to select color. Refer to the Drawings for color locations.
  7. Basis of Design: FW-120-2 by MBCI or comparable product approved by Architect.

## 2.5 ROOF ACCESSORIES

- A. Eave Gutters: Roll-formed 24 gauge steel sheet in 10 foot or longest practical length, with gutter straps, fasteners and joint sealant. Snap-on gutter straps shall be provided for ease in erection at a maximum spacing of 5 feet-0 inches. Design of the gutter will permit rapid installation or removal after roof and wall sheets are in place. Gutter shall screen the eave ends of roof sheets from view. No portion of the gutter will protrude under the roof panels. Color shall be Sherwin Williams' Fully Purple, Color Number 6983 or comparable product approved by Architect.
- B. Downspouts: Shall be 24 gauge steel sheet in 10 foot or longest practical length, rectangular shaped with 16 gauge boot to 6'-0" above finished grade. Downspouts shall have a 45 degree elbow at the bottom and shall be supported by attachment to the wall covering at 10 feet maximum spacing. Color shall be same as wall panels.

## 2.7 ROOF INSULATION SYSTEM

- A. Batt or Roll Thermal Insulation:
  - 1. Type: ASTM C665, Type 1.
  - 2. R-Values (minimum): R-30, total.
  - 3. Surface Burning Characteristics:
    - a. Flame Spread: 25 or less.
    - b. Smoke Developed: 50 or less.
  - 4. Size/Thickness: 6 inch vinyl faced over purlin, plus 8 inch unfaced in insulation cavity; unless indicated otherwise on drawings. Vinyl side towards attic/plenum space.
  - 5. Approved Manufacturers/Products:
    - a. CertainTeed Corp. (AcoustaTherm)
    - b. Guardian Fiberglass, Inc.(Thermal Control Batts)
    - c. Johns-Manville (Thermal-SHIELD Thermal Insulation)
    - d. Knauf (Thermal Batt Insulation)
    - e. Owens-Corning (Thermal Batt Insulation).
- B. Vapor Barrier Facing:
  - 1. Shall be either a vinyl film (3.2 mil thickness) or vinyl reinforced polyester (VRP) film (3 mil approximate thickness). Vinyl reinforced polyester facing is recommended when air temperatures of 30 degrees F or below are anticipated during shipment or erection.
  - 2. Shall have an Underwriters' Laboratories flame spread rate of 25 or less and a smoke developed rating of 50 or less.
  - 3. Shall have a water vapor transmission value of 1.00 perms for vinyl film facing and 0.02 perms for VRP facing.
  - 4. Color: Shall be white.
  - 5. Width: Shall be 78 inches so as to provide a 3-inch tab projecting beyond each side of the fiberglass blanket.
- C. Provide thermal break on top of purlin to separate structural steel and girders from aluminum roof panels.

## 2.9 SHEET METAL ACCESSORIES

- A. General: Provide coated steel sheet metal accessories with coated steel roofing and siding panels.
- B. General: Provide aluminum sheet metal accessories with aluminum roofing and siding panels.
- C. Metal Fascia: Provide color to be fully purple #6983 by Sherwin Williams (SW).
- D. Gutters: Form in 8-foot-long sections, complete with end pieces, outlet tubes, and other special pieces as required. Size in accordance with SMACNA. Join sections with riveted and soldered

or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports spaced 36 inches on center, constructed of same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets.

1. Finish: Powder coated. Fully purple #6983 by Sherwin Williams (SW).
- E. Downspouts: Form in 10-foot-long sections, complete with elbows and offsets. Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 5 feet on center in between. Finish to match wall panels.
- F. Roof Ventilators: Provide low-profile, ridge-type circular gravity roof ventilators, size and spacing indicated. Furnish with matching base, bird screen, hood, flashing, closures, and fittings. Finish to match roof panels.
1. Provide directional revolving-type gravity roof ventilators.
  2. Provide stationary revolving-type gravity roof ventilators.
  3. Reinforce and brace units, with joints properly formed and edges beaded to be watertight under normal positive pressure conditions. Mount ventilators on square-to-round bases designed to match roof pitch and roll-formed to match corrugation profile of roof panels.
  4. Provide bird screens of 1/2-inch by 1/2-inch galvanized steel or aluminum mesh.
  5. Provide pull-chain-operated, spring-loaded disc-type damper, with fusible link connection.
- G. Wall Louvers: Provide louvers, size and design indicated, of 18-gage (0.0478-inch) steel. Fold or bead blades at edges, set at an angle that excludes driving rains, and secure to frames by riveting or welding. Finish to match wall panels.
1. Provide vertical mullions for louvers 4 feet and more in width, with one mullion for each 4 feet of width.
  2. Provide flanges on interior face of frames where air intake or exhaust louvers are indicated to be connected with mechanically operated dampers or metal ductwork.
  3. Provide 1/2-inch by 1/2-inch galvanized steel mesh bird screens in rewirable frames on exterior face of louvers. Secure with clips to ensure ease of removal for cleaning and rewiring. Fabricate screens and frames of same type metal as louvers.

## **2.10 FABRICATION**

- A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.
1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
  2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.
1. Shop Connections: Provide power riveted, bolted, or welded shop connections.
  2. Field Connections: Provide bolted field connections.

## **PART 3 - EXECUTION**

### **3.1 ERECTION**

- A. Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a



nonshrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.

- B. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.
- C. Bracing: Provide diagonal rod or angle bracing in roof and sidewalls as indicated.
  - 1. Movement-resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards.
  - 2. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required.
- D. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical Work. Securely attach to building structural frame.

### 3.2 ROOFING AND SIDING

- A. General: Arrange and nest sidelap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.
  - 1. Field cutting of exterior panels by torch is not permitted.
  - 2. Provide weatherseal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.
- B. Standing-Seam Roof Panel System: Fasten roof panels to purlins with concealed clip in accordance with the manufacturer's instructions.
  - 1. Install clips at each support with self-drilling fasteners.
  - 2. At end laps of panels, install tape calk between panels.
  - 3. Install factory-calked cleats at standing-seam joints. Machine-seam cleats to the panels to provide a weathertight joint.
- C. Wall Sheets: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with the sealant manufacturer's recommendations.
  - 1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws. Fasten window and door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
  - 2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
  - 3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- D. Sheet Metal Accessories: Install gutters, downspouts, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weathertight mounting. Adjust operating mechanism for precise operation.
- E. Hollow Metal Doors and Frames: Install doors and frames straight, plumb, and level. Securely anchor frames to building structure. Set units with 1/8-inch maximum clearance between door and frame at jambs and head and 3/4-inch maximum between door and floor. Adjust hardware for proper operation.

- F. Overhead Coiling Doors: Set doors and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with manufacturer's instructions. Adjust moving hardware for proper operation.
- G. Thermal Insulation: Install insulation concurrently with installation of roof panels in accordance with manufacturer's directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.
- H. Cleaning and Touch-Up: Clean component surfaces of matter that could preclude paint bond. Touch up abrasions, marks, skips, or other defects to shop-primed surfaces with same type material as shop primer.
- I. Translucent Panels: Attach plastic panels to structural framing in accordance with the manufacturer's instructions.
  - 1. Provide end laps of not less than 6 inches and side laps of not less than 1-1/2 inch corrugations for translucent roofing panels.
  - 2. Align horizontal laps with adjacent roofing panels.
  - 3. Seal intermediate end laps and side laps of translucent panels with translucent mastic.
  - 4. Clean panels in accordance with manufacturer's instructions.

**END OF SECTION 13 34 19**

## **SECTION 13 34 23 PRE-ENGINEERED MODULAR BUILDINGS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes but is not limited to:
  - 1. Pre-engineered, steel frame, clear span modular buildings, fully code-compliant, complete and ready for use.
  - 2. Lifted concrete stem wall foundation and/or steel lift-jack pier support with skirts (or flush to grade).
  - 3. Pre-engineered ramp, platform, and steps for raised conditions.
  - 4. Transportation from the factory to the site, erection, installation, and finishing at the site including all materials, equipment, and operations described in the Contract Documents.
  - 5. Connection of site utilities.
  - 6. Connection to fire alarm system.
  - 7. Connection to fire sprinkler system.
  - 8. Connection to communications.
- B. Related Sections:
  - 1. Section 01 33 00: Submittal Procedures.
  - 2. Section 03 30 00: Cast-in-Place Concrete.
  - 3. Section 05 50 10: Metal Fabrications.
  - 4. Section 06 10 00: Rough Carpentry.
  - 5. Section 06 20 00: Finish Carpentry and Millwork.
  - 6. Section 08 71 00: Door Hardware.
  - 7. Section 09 90 00: Painting and Coating.
  - 8. Section 31 00 00: Earthwork.
  - 9. Section 33 00 00: Utilities.
  - 10. Division 21: Fire Suppression.
  - 11. Division 22: Plumbing.
  - 12. Division 26: Electrical.
  - 13. Division 27: Communications.
  - 14. Division 28: Fire Alarm Systems.
  - 15. Other related work is specified in pertinent sections elsewhere in the Contract Documents and may or not be noted in this Section.
- C. Attachments: Geotechnical Engineering and Geologic Hazards Study.
- D. Reference Standards:
  - 1. AISC 5335 Specification for Structural Steel Buildings Allowable Stress Design, Plastic Design; American Institute of Steel Construction, Inc.
  - 2. Division of the State Architect Interpretation of Regulations (IR) Manual, latest edition.
- E. Products Supplied But Not Installed Under This Section:
  - 1. Modular contractor's responsibility for completion of design:
    - a. All elements required for buildings to be fully code compliant, complete, and ready for use, including all entries, access to cabinets, teaching walls, and controls.

- b. Coordination with site contractor for exact location of utilities, power, fire alarm, fire sprinkler, and communications hook-ups and operations.
  - c. Coordinate with site contractor for Project completion to meet requirements of the District and this Project manual.
  - d. Building transportation and placement.
  2. Design load criteria: Refer to Structural Drawings.
  3. Design buildings to be transportable:
    - a. Modules capable of transportation on trailers allowed for shipping on public streets and highways. The uppermost portion of the module or panel shall not exceed 16 feet from the road surface during transport.
  4. Provide weathertight and watertight construction at all stages of work.
  5. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range not exceeding that of the maximum annual range of variation found at the Project site, as determined by the National Weather Service records.
  6. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.
  7. Provide secure and safe design conforming to standards of care for similar work prevailing in the area where the Project is located.
- F. Products Installed but Not Supplied by Modular Contractor:
1. Site contractor shall provide and pay for all of the following items necessary for proper execution and completion of the work, temporary or permanent, to be incorporated into the Work for this Project:
    - a. Labor.
    - b. Materials.
    - c. Equipment.
    - d. Tools.
    - e. Construction equipment and machinery including, but not limited to, earth moving equipment and compaction of soil required for installation of modular buildings.
    - f. Site utilities (water, sewer and storm sewer, electrical, fire sprinkler, fire alarm, and communications).
    - g. Fencing and security.
    - h. All other facilities and services necessary, wherever located.
  2. Coordinate with modular building Drawings for foundation work (stem wall construction, slab on grade construction, and/or pier lift and skirt construction).
  3. The modular building manufacturer must also be the General Contractor and installer of the building. No building brokering allowed.
  4. Site contractor shall be responsible for selecting and coordinating all construction means, methods, techniques, sequences, and procedures.
  5. Review all Contract Documents thoroughly and coordinate all components to meet performance requirements indicated, coordinate systems to avoid conflicts, and provide all elements necessary to meet the requirements of this Specification and complete the Project for occupancy and use subject to all requirements of prevailing codes.

### 1.3 SUBMITTALS

- A. Construction Documents:
1. Submit to the Architect complete Plans and specifications including:
    - a. Structural, mechanical, fire sprinkler, and electrical design drawings and details.
    - b. Energy efficiency compliance documentation:
  2. All drawings, details, specifications, and calculations shall be stamped and signed by an architect, structural engineer, mechanical engineer, electrical engineer, and professionals of such other disciplines as may be necessary or required, all currently licensed by the State of Texas.

3. Architect will review and comment on these submittal documents and return to modular contractor for corrections.
- B. Shop Drawings:
1. Indicate assembly dimensions, locations of structural members, and connections.
  2. Wall and roof system dimensions, general construction details, anchorages and method of anchorage, installation, and door, window, and finish schedules.
  3. All details necessary to describe the complete building, systems, components and their relationships to work provided under separate contracts, framing anchor bolt settings and their sizes and locations from datum, and structural attachments.
  4. Indicate welded connections with AWS A2.4 welding symbols.
  5. Indicate net weld lengths.
  6. Provide professional seal and signature.
  7. Initial submittal to the Architect: One (1) reproducible and three (3) prints of complete sets of drawings, calculations, and specifications, complete with original stamps and signatures of all design professionals.
- C. Samples: Submit two (2) samples of factory finished materials for each material, product, and color selected, eight by ten inch (8" x 10") in size, or as otherwise specified in the related Sections, illustrating color and texture of finish.
- D. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement, and all information necessary to coordinate work provided by separate contracts.
- E. Submit original written certifications of the manufacturer and installer qualifications specified in Quality Assurance paragraphs of this Section.
- F. Project Record Documents: Record all changes made during construction and actual locations of concealed components and utilities.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design, fabricate, and erect building structure and exterior cladding to withstand:
1. Loads from wind, seismic, gravity, thermally induced and other structural movement, weather exposure, and other conditions of use normally encountered.
  2. Applicable loads and combined loads as required by the International Building Code.

#### **1.5 QUALITY ASSURANCE**

- A. Submit Evidence of Confirming Qualifications:
1. Manufacturer qualifications: Specializing in design and fabrication of modular school building systems of the specific type and quality indicated, in Texas, for a minimum of 20 years, with evidence of satisfactory completion of minimum of five (5) projects of similar scope and scale within the last five (5) years.
  2. Installer qualifications: Specializing in erection and installation of modular building systems for minimum of 20 years with evidence of satisfactory completion, of minimum of five (5) projects of similar scope and scale within the last five (5) years, approved and certified in writing by the manufacturer.
- B. Inspection and Material Testing of Prefabricated Buildings Divided Into Two Separate Components:
1. Plant inspection and material testing.
  2. Onsite inspection and material testing.
  3. All inspectors shall be retained by the Owner.

- C. All materials used, unless otherwise specified, shall be new and of the types and grades specified. Contractor shall furnish confirming evidence satisfactory to the Project Architect upon request.
- D. All workers, in plant or field, shall be skilled and qualified for the work to be performed.
- E. Design structural components, develop shop drawings, and perform shop and sitework under direct supervision of a professional structural engineer experienced in design of this Work and licensed in the State of Texas:
  - 1. Cooperate with inspectors, regulatory and testing agency or authority, and provide data as requested.
- F. Perform work in accordance with AISC "Specification for Structural Steel Buildings-- Allowable Stress Design, Plastic Design."
- G. Perform welding in accordance with AWS D1.1.
- H. Pre-Installation Meeting:
  - 1. To be conducted at Project site a minimum of one (1) week before starting work of this Section.

## **1.6 WARRANTY**

- A. Correct defective work within a one (1) year period after date of Substantial Completion.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Handle work with care. Avoid damage during delivery, erection, and placement.
- B. Replace all damaged work prior to installation. Do not install damaged work or materials.
- C. Deliver prefabricated components, materials, and manufactured items undamaged. Package, wrap, or provide temporary coverings to protect all or parts of buildings from the elements and from transportation damage.
- D. Acceptance at Site: Inspect work as it is delivered. Reject work exhibiting damage and provide new undamaged work. Reject work not accompanied with the in-plant inspector's certificate.
- E. Protect delivered work from weather and related construction operations, including those of other contracts. Maintain work in undamaged condition until erection and placement.
- F. Refer to related Sections for additional specific requirements.
- G. Coordinate with site contractor for staging areas, crane locations, and parking a minimum of one (1) week prior to delivery.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Modular Buildings:
  - 1. Basis of Design: Products manufactured by WillScot, Houston, TX; (713) 280-0655. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements

regarding substitutions to be considered

- B. Substitutions: See Section 01 25 00: Substitution Procedures and Form. Substitutions are subject to compliance with qualifications specified in the Quality Assurance paragraphs of this Section.

## **2.2 GENERAL - MANUFACTURED UNITS**

- A. Modular Buildings: Complete, as indicated and specified, conforming to architectural design and appearance indicated, constructed of modules or panels comprising of exterior walls and roofs as shown. All wall and roof joints watertight and weatherproof.
- B. Meet all requirements of Title 24 Parts 1 and 2, and Division of the State Architect Interpretation of Regulations. All areas and portions of the Project shall be fully accessible. Coordinate with site contractor all site related work with path of travel.
- C. Design buildings to conform to architectural design and appearance indicated. Select components and design systems to provide functions and amenities indicated, as well as those that are required by the prevailing codes and agencies having jurisdiction, whether or not shown in the Contract Documents.
- D. In the event of conflicts, recommend mode of resolution requiring minimum revision to indicated design concept and request direction from Architect. Do not revise or modify design concepts without written acceptance of Architect.
- E. The modular building manufacturer's term contract is the minimum scope of work or level of quality to be provided unless otherwise indicated. In the event of conflict between the modular contractor and the site contractor, including this Project manual, having the greater scope or higher quality as specified, including this Section, shall govern. Site contractor to coordinate with modular contractor for exact location of all utility, water, electrical, fire alarm, and connections to complete this Project including location of landscape irrigation and planting.
- F. Dimensions and Tolerances: Minimum ceiling height is eight feet (8'-0"). Plan dimensions indicated may vary within tolerances of plus or minus three inches (3") to allow flexibility in module or panelization layouts. Clearly indicate all deviations from indicated dimensions or pitches on shop drawings and request specific review from Project Architect in writing prior to any site construction work..
- G. Design buildings to be transportable over highways to the Project site if transportation of components is necessary. Identify potential design conflicts with maximum transportable sizes. Recommend mode of conflict resolution and request direction from Project Architect. Do not construct buildings or components that cannot be transported lawfully or safely on Texas roadways.

## **2.3 FOUNDATIONS, FLOORS-ON-GRADE, SUBSTRUCTURE**

- A. Field Engineering: Site contractor to provide, where required by documentation for this Project, field surveying and field engineering services not otherwise required by the modular contractor for complete installation of all parts of the building and its components for this Project. Locate buildings, utilities, site features, and other construction, and establish elevations and grades from identified benchmarks to ensure proper installation of modular building parts to meet design criteria for this Project.
- B. Slab-on-Grade Floor System:

1. Design and provide permanent concrete slab-on-grade system that meets the recommendations of geotechnical reports.
2. Design slabs and structural cross sections to fit within subgrade elevations and finish floor elevations indicated. Select concrete mix designs and reinforcement to provide structural values required within dimensional constraints indicated. Perform all additional subgrade excavation required to provide for thicker structural sections as designed by Contractor's Engineer.
3. Contractor's Engineer is responsible for design of slab-on-grade floor systems in accordance with recommendations of geotechnical reports referenced as related documents.
4. Select and provide vapor barrier system, topical vapor transmission coating, or concrete mix design to ensure that moisture transmission through concrete slab remains below recommended levels of specified floor coverings. All floor slabs shall be acceptable substrates for specified floor coverings, enabling provision of full manufacturer's warranties for floor coverings.

## 2.4 SUPERSTRUCTURE

- A. Steel Frame: Two-dimensional moment resisting steel frame with bolted or welded connections.
- B. Provide clear span construction free of interior columns or pilasters.

## 2.5 ROOF STRUCTURE

- A. Roof Structure: Steel beams and purlins, corrugated metal roof deck/shear diaphragm.
- B. Roof slope shall be minimum two inches (2") per foot.
- C. Roof Overhang – Plywood:
  1. All overhangs shall present a pleasing and finished appearance.
  2. Soffits shall be enclosed with plywood without visible framing or protruding fasteners.
  3. Plywood soffit material shall be applied with long direction running parallel to the length of the building.
  4. Soffits shall be neatly and closely fitted and trimmed without gaps.
- D. Roof Overhang - Metal Soffit:
  1. All overhangs shall present a pleasing two-part metal fascia of same type of material as soffit.
  2. Soffits shall be enclosed metal soffit perpendicular to adjacent wall surface.
  3. Soffit to be neatly closed and sealed.

## 2.6 EXTERIOR ENCLOSURE

- A. Watertight and Weatherproof:
  1. Provide complete metal and flexible flashings and trim for watertight and weatherproof construction. Design building envelope flashing systems in accordance with SMACNA standards.
  2. All weather-exposed surfaces shall have a weather-resistive barrier equivalent to two (2) layers of Grade D Kraft waterproof building paper conforming to ABC, Title 24, Part 2 for asphalt-saturated rag felt.
  3. Barrier shall be free from holes and breaks other than those created by fasteners and construction systems for attachment of the building paper and shall be applied over studs or sheathing of all exterior walls. Such barrier shall be applied weather-board fashion, lapped, and wrapped at corners.



4. Provide sheet metal flashings separating concrete from structure at all perimeter locations.
- B. Insulation:
1. Walls shall have an insulation rating of R-19 minimum.
  2. Roof shall have an insulation rating of R-30 minimum. Insulation shall be designed to ensure that there is no condensation on interior surface of the corrugated metal roof deck.
  3. Insulation vapor barrier shall be installed to the heated side. Provide type FSK barrier where located above suspended ceilings.
  4. Floor shall have an insulation rating of R-30 minimum.
- C. Doors and Hollow Metal Frames:
1. Exterior Doors: Flush doors, minimum dimensions three feet by seven feet by 1-3/4 inch (3'-0" x 7'-0", 1-3/4") thick, 18-gauge, with steel face sheets. Factory prepare and reinforce for indicated finish hardware, including reinforcement on both faces for closers.
  2. Interior Doors: Flush doors, minimum dimensions three feet by seven feet by 1-3/4 inch (3'-0" x 7'-0", 1-3/4") thick, with maple veneer face sheets. Finish doors with clear sanding sealer finish. Factory prepare and reinforce for indicated finish hardware, including reinforcement on both faces for closers.
  3. Hollow metal frames shall be 16-gauge at exterior openings and 18-gauge at interior openings, depth to suit wall thickness. Jamb throats shall capture all wall cheating panels or materials. Do not permit paneled finishes butted to door frames returns. Provide three (3) anchors minimum per jamb and adjustable floor anchor at bottom of each jamb. Prepare and reinforce for specified and required hardware, including strike box and reinforcement for closers on all frames.
  4. Sound deaden concealed faces with 1/8-inch thick undercoating or fill metal door frame cavity with insulation to attain the sound-deadening requirement. Chemically treat doors and frames for paint adhesion and apply one (1) complete shop coat of metal primer, prepared for field finish specified elsewhere.
  5. Design, coordinate, and install door and frame systems with other related work for complete waterproof and watertight systems without conflict or omission in weatherproof enclosures.
- D. Windows:
1. Provide thermally broken aluminum nail-fin type windows in configuration shown on the Drawings. Provide operable sections as indicated.
  2. Glazing: Provide dual pane insulated glazing with a low-e coating. Color to be selected by Project Architect.
  3. Exterior side of window openings in plaster walls shall self-trim into the plaster.
  4. Exterior side of window openings in plywood wall shall have minimum edge clearance on all sides and have one inch (1") minimum trim on all sides. Refer to exterior elevations for details.
  5. Interior side of window openings shall be completely cased with solid wood trim, opaque finish. Windows located or sized so that sill heights are seven feet (7') or more above floor elevation may be self-trimmed by the wallboard only.
  6. Header: Typical window header height shall be the same as the door, unless otherwise shown.
  7. Design, coordinate, and install window systems with other related work for complete waterproof and watertight systems without conflict or omission in weatherproof enclosures.
- E. Hardware for Exterior Doors and Interior Doors: See Section 08 71 00: Door Hardware.
- F. Painting: Paint all exposed surfaces, including cement plaster. Refer to Section 09 90 00:

Painting and Coating.

**2.7 ROOFING**

- A. Design, coordinate, and install roofing systems with other related work.
- B. Flashing, Gutters, Trim, and Seismic Joints: Provide complete flashing and trim for watertight and weatherproof construction. All roof drainage diverted to roof drains and drained into downspouts extending to below grade storm drain system.
- C. Rain Drainage Work: Downspouts with any part located eight feet (8') or less above finish exterior grade shall be welded Schedule 40 steel pipe construction and brackets. All downspouts extending to finish exterior grade shall sheet drain.

**2.8 INTERIOR CONSTRUCTION**

- A. Partition and demising wall framing shall be six-inch (6") metal studs, minimum, and greater as determined by modular contractor's structural engineer.
- B. Sound Attenuation: All interior partitions shall be provided with fiberglass sound insulation and acoustical sealant at top, bottom, and all openings to create a partition with a Sound Transmission Class (STC) rating of 45 or higher. All interior partitions shall extend full height to the underside of the roof deck unless otherwise noted on approved Drawings.
- C. Flooring/Base:
  - 1. Provide four-inch (4") high resilient base, coved at resilient flooring and straight type at carpeting, at floor-to-wall junctions and cabinet bases.
  - 2. Carpet: Style and color to be selected by Project Architect from manufacturer's standard range. Install per manufacturer's instructions.
  - 3. Resilient Flooring:
    - a. Base bid - Style and color to be selected by Project Architect from manufacturer's standard range. Install per manufacturer's instructions.
- D. Interior Wall Finishes:

All walls shall be covered with gypsum wallboard. Gypsum wallboard not concealed by other finishes shall be finished, textured, and painted.

  - 1. Tackboard wall: Walls shall be covered with vinyl covered tackboard applied without horizontal joints. Vertical joints shall be covered with manufacturer's standard pre-finished joint cover splines matching vinyl color.
  - 2. Toilet room walls, and other walls backing of water service fixtures, shall have ceramic tile. Student toilet rooms shall have ceramic tile to seven feet (7') in height on all walls. Staff toilet rooms shall have ceramic tile to seven feet (7') in height on two (2) walls adjacent to sink and toilet:
    - a. Ceramic tile shall be installed over 1/2-inch cementitious backer board.
    - b. Install according to Ceramic Tile Institute of America guidelines.
  - 3. Custodial room walls and other walls as indicated shall have fiber-reinforced wall panel wainscots to seven feet (7') high unless otherwise indicated on approved Drawings.
- E. Ceiling:
  - 1. Typical acoustical panels shall be 5/8-inch minimum thick, mineral fiberboard, or vinyl-faced fiberglass lay-in panels, square edge, ASTM flame-spread index Class I (O-25), 24 inches by 48 inches modular size, light reflection 75 percent minimum, noise reduction coefficient of 0.65 minimum.
- F. Painting: Paint all exposed surfaces that are not factory finished.

## 2.9 PLUMBING

- A. Modular contractor shall design and provide a complete plumbing system comprising of:
  - 1. Domestic hot and cold water piping systems.
  - 2. Drain, waste, and vent piping systems.
  - 3. Gas piping system.
  - 4. Plumbing fixtures and trim.
  - 5. Gas and water shut-off valves capable of isolating building systems from site systems.
- B. All piping shall be concealed within the building structure or within chases.
- C. Coordinate exact location of connections with site contractor or extend piping systems to points-of-connection with site utilities at locations indicated on Drawings. Provide shut-off valves and grade boxes within five-foot (5') perimeter of the building. Coordinate with site contractor to bring clean-outs and grade boxes to finish grade. Coordinate in landscape areas or on concrete/asphalt paved areas with site contractor.
- D. Size piping on the basis of fixture or appliance demand. Provide shut-off and isolation valves to permit maintenance and repair without undue interruption of service to other units. Install piping to prevent damage to structure or pipe supports from thermal expansion or contraction of piping systems.
- E. Route and install piping systems to avoid conflicts with structure while remaining concealed. Provide chases, furring, or enlarged framing to allow piping to pass around structural framing without exceeding code-imposed limits on openings allowed in framing.

## 2.10 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

- A. Modular contractor shall design and provide a complete HVAC system comprising of:
  - 1. Forced air unit located in mechanical closet or as exterior hung unit on rear wall side.
  - 2. Ductwork, registers, and air diffusers.
  - 3. Controls.
  - 4. Testing and balancing of ventilation system.
- B. Reference Brand Carrier, or equal. Air filters shall be two inches (2") thick pleated media, disposable type. Filters shall be 30 percent efficient per ASHRAE standard 52.
- C. The mechanical ventilation system shall provide a minimum of 15 cubic feet of outside air per minute per occupant, with one (1) occupant per 20 square feet of floor area.
- D. The system shall maintain an automatically controlled indoor classroom temperature of 75 degrees F in summer and 70 degrees F in winter with a 40-60 percent relative humidity when the outdoor temperature varies between 98 degrees F dry bulb (69 degrees F wet bulb) and 28 degrees F dry bulb.
- E. The system must maintain the specified temperatures when providing outside air as indicated.
- F. HVAC equipment electrical characteristics shall suit the site requirements.
- G. Ductwork constructed of galvanized sheet metal in accordance with ASHRAE, and SMACNA Low Velocity Duct Construction Manual, latest editions:
  - 1. All ductwork shall be concealed within the building walls, floor, ceiling, or in soffits or chases, unless specifically shown otherwise in the Architect's Drawings. Request specific direction from Architect for re-routing of ductwork or for use of exposed

ductwork. All exposed ductwork shall be round spiral-wound material designed and manufactured for exposed locations.

2. Insulate with one-inch (1") fiberglass duct wrap with vapor barrier, include one-inch (1") duct attenuation within eight feet (8') of HVAC unit.
3. Rigid one-inch (1") fiberglass or insulated "Flex-Duct" conforming to NFPA 90-A, 90 B and SMACNA Class 1 may be substituted for metal ductwork in accessible concealed portions of the duct system.
4. Registers and diffusers: Provide minimum of two (2) four-way air supply diffusers per room, located to provide maximum feasible air distribution. Diffusers shall not be sized larger than 400 cfm each and shall have a NC-30 or less.
5. Ducted return: Provide ducted return air design. Direct-coupled return air registers are not acceptable.

## **2.11 FIRE PROTECTION**

- A. Design and provide a complete fire protection system, if required.

## **2.12 ELECTRICAL**

- A. Design and provide a complete electrical system comprising of line voltage power outlets and distribution and panel boards to provide complete operational systems.

## **2.13 LIGHTING**

- A. Design and provide a complete lighting system comprising of:
  1. Interior fixtures of types and quantities to meet the following standards:
    - a. Selected and spaced to provide minimum overall average illumination of 50-foot candles at desk level (30 inches above floor elevation) and comply with IES recommendations for classroom interiors otherwise.
    - b. Exterior fixtures to have translucent vandal-resistant housing with corrosion-resistant metal housing, high-pressure sodium or metal-halide type, securely attached to building structure adjacent to all exterior doors and as otherwise required to provide minimum overall average illumination complying with IES recommendations for exterior walkways.
    - c. All lighting in classrooms and small rooms shall be controlled by occupancy sensors.
    - d. Exterior lighting shall be controlled by an astronomical timeclock.

## **2.14 FIRE ALARM AND DETECTION**

- A. Provide conduit and junction boxes with pull strings for interior and exterior initiation devices, horn-strobes, terminals, and other devices as shown.
- B. Seal conduits and boxes with weatherproof covers and leave in condition for components, wiring, and final connections by sitework contractor.

## **2.15 SIGNAL, DATA, AND TELECOMMUNICATIONS**

- A. Provide conduit and junction boxes with pull strings for interior and exterior devices.
- B. Telecommunications and signal device locations for rough ins will be based on sitework electrical plans and documents.
- C. Seal conduits and boxes with weatherproof covers and leave in condition for components, wiring, and final connections by sitework contractor.

## 2.16 EQUIPMENT AND FURNISHINGS

- A. Cabinets and Casework:
  - 1. Refer to specification.
- B. Marker Boards and Tack Boards
  - 1. Refer to specification.
- C. Television Wall Brackets: One (1) located in the conference room as indicated. Brackets shall be capable to support an 80-inch flat panel television.
- D. Fire Extinguishers and Cabinets:
  - 1. Each exterior door shall be equipped with a pressure type fire extinguisher with 2A-10BC UL rating mounted at a height of four feet (4') on the interior wall near the doorway.

## 2.17 SITE PREPARATION

- A. Site preparation and building pad preparation to be performed by site contractor.
- B. Perform fine grading within perimeter of building foundations prior to permanent placement of buildings; ensure positive drainage to under-building drains.

## 2.18 SITE SERVICES

- A. Certain site service utilities are provided by site contractor.
- B. Site contractor to connect site service utilities to modular buildings as follows:
  - 1. Rain drainage: Site contractor to connect building systems to stub-out provided by sitework contractor.
  - 2. Sanitary sewer: Modular contractor to connect building systems to stub-out provided by sitework contractor.
  - 3. Domestic water: Modular contractor to connect building systems to stub-out at valve in grade box provided by site contractor.
  - 4. Fire water: Modular contractor to provide post indicator valve and connect building systems to stub-out provided by site contractor.
  - 5. Modular contractor to provide conduit and wire to connect P.I.V. tamper switch to new fire alarm panel.
  - 6. Gas: Modular contractor to connect building systems to stub-out at valve in grade box provided by sitework contractor.
  - 7. Electrical power: Modular contractor to connect conduit raceways from building systems to stub-out provided by sitework contractor. Sitework contractor shall pull conductors and make final connections inside modular building panel.
  - 8. Clock: Modular contractor to connect conduit raceways from building systems to stub-out provided by sitework contractor. Site contractor shall pull conductors and provide active devices and terminations and all final connections inside modular building.
  - 9. Bell: Modular contractor to connect conduit raceways from building systems to stub-out provided by site contractor. Site contractor shall pull conductors and provide active devices and terminations and all final connections inside modular building.
  - 10. Intercom/public address: Modular contractor to connect conduit raceways from building systems to stub-out provided by sitework contractor. Site contractor shall pull conductors, provide active devices and terminations and all final connections inside modular building.
  - 11. Telephone: Modular contractor to connect conduit raceways from building systems to stub-out provided by site contractor. Site contractor shall pull conductors and provide

- active devices and terminations and all final connections inside modular building.
12. Data/fiberoptic: Modular contractor to connect conduit raceways from building systems to stub-out provided by site contractor. Site contractor shall pull conductors and provide active devices and terminations and all final connections inside modular building.
  13. Television: Modular contractor to connect conduit raceways from building systems to stub-out provided by site contractor. Site contractor shall pull conductors and provide active devices and terminations and all final connections inside modular building.

## 2.19 ACCESSORIES

- A. Modular contractor to provide complete functional buildings:
  1. Design, select, and provide all building elements, incidental fasteners, sealants, components, flashings, and fittings necessary to finish the work complete with all performance characteristics as indicated, specified, and as needed to comply with referenced and prevailing codes.
- B. No allowances for additional sums will be made for Modular contractor's errors, omissions, or failure to design all required conditions in completion of the building design or construction.

## 2.20 MIXES

- A. Mixes for the Modular Structure: Concrete, mortar, grout, and other mixes shall be designed by the modular contractor's design professionals in conformance with requirements of the Contract Documents.

## 2.21 FABRICATION

- A. Modular Plant Fabrication Required: Perform building fabrication under factory conditions in a plant designed for this type of work. Provide adequate space, equipment, materials, licensed design services, and technical personnel to fabricate, coordinate, assemble, pack, ship, and install all required building components in controlled conditions.
- B. Shop welding shall comply with AWS D1.3 for cold-formed steel. Do not commence welding operations until the welding inspector has inspected and accepted materials, joint preparation, equipment, and qualifications of the operators. Unsatisfactory work shall be removed and replaced with conforming work.
- C. Provide for temperature expansion/contraction movement and seismic movement of building elements. Design and fabricate expansion control in accordance with prevailing codes and Contractor's design calculations.
- D. Fabrication testing and inspection shall be performed at the plant.
- E. Do not fabricate until materials are tested and accepted. Do not fabricate with untested materials.
- F. Framed Openings: Provide openings of shape, size, location, and design to accommodate systems requiring penetrations. Reinforce openings with structural elements sized to resist loads and vibrations imposed, including mechanical and electrical work. Securely attach all framing to structure.
- G. Provide for fabrication and wind loads. Provide temporary bracing to maintain work plumb and in alignment until completion of erection and installation of permanent bracing.

- H. Select fabrication methods and processes to avoid transmission of erection or fabrication loads to fabricated members. Avoid locking-in stresses.
- I. Prepare all work true to indicated shapes and dimensions required. Form all components true to required shape, accurate in size and radius, square, and free from distortion or defects. Cut materials to precise lengths indicated from field measurements.
- J. Machine-roll elements required to be curved or radiused. Do not field bend or "walk-down." Provide true curves; segmented fabrication not allowed.
- K. Store completed work at the fabrication plant under conditions that will prevent damage or deterioration until work can be transported to the Project site. Repair damage prior to transport. Do not transport damaged or unacceptable work.
- L. Do not store completed work at the Project site. Do not transport completed work until Project site is prepared to accept building modules for prompt installation.

## **2.22 FINISHES**

- A. Exterior and interior finishes shall be as indicated on the Drawings. Exposed finishes shall be site-applied to the greatest extent feasible.
- B. Painting: All exterior and interior finishes shall be painted.

## **2.23 SOURCE QUALITY CONTROL**

- A. Inspection: Plant inspection and material testing shall be performed under the supervision of the in-plant inspector. Provide the inspector with full access to all plant operations involving work under this contract. Notify the inspector in advance of the time and place when operations requiring inspection or observation are to take place.
- B. Inspector shall inspect all components for acceptability and issue a written certificate. A copy of the signed certificate shall accompany each building to the site. Do not release components from plant without this certificate.
- C. The inspector shall examine the workmanship of each welder prior to incorporation of the individual's welding into the Work. Unsatisfactory welders shall be removed by the inspector and replaced with qualified personnel. Welders so removed shall be required to pass qualification tests before returning to work.
- D. Every layer of weld shall be inspected for quality. Each layer of multiple pass welds shall be fully inspected before the succeeding layer is applied. Each joint shall be inspected for conformance with the Contract Documents. Full penetration butt welds shall be made only in the presence of the welding inspector.
- E. Single pass welds may be inspected after the welding is completed, except for conditions requiring continuous inspection.
- F. The welding inspector shall use all means necessary to determine the quality of the welds.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that civil, mechanical, and electrical utilities are proper types in correct position.

- B. Verify building pads and adjacent subgrades are certified elevations, properly compacted and moisture conditioned.
- C. Verify that adjacent structures, foundations, and items in related contracts are proper types in correct positions.

### **3.2 PROJECT CONDITIONS**

- A. Coordination of Work:
  - 1. Comply with requirements for coordination specified elsewhere and the following:
    - a. Make all necessary arrangements with the District's authorized representative and other separate contractors for access to grounds, removal of obstructions, and preparation of delivery routes. This contact shall be made at least 48 hours in advance of delivery of any module, building component, equipment, or material.
- B. Visit the site to verify readiness to receive building modules, components, or equipment. If work is delivered before site is prepared to receive it, modular contractor shall be responsible for all costs incurred including, but not limited to, inspector's time and costs accruing to separate contractors or others for accommodating this out-of-sequence work.
- C. Continuously coordinate this work with that of separate contractors. Attend progress meetings of separate contractors, cooperate with separate contractors, provide and request all data concerning schedules, access, storage and handling, and all such other information as requested or necessary to fully complete the work, free of conflicts or omissions.

### **3.3 INTERFACE WITH OTHER WORK**

- A. Coordinate the modular building erection and installation with other contracts. Ensure construction of complete and functional systems, free of conflict or omission. Allow access to other contracts to complete work related to this contract.

### **3.4 SEQUENCING**

- A. Sequence the work to coordinate with the activities of separate contractors and specific sequences as indicated or implied.
- B. Sequence work to avoid interference with adjacent construction.
- C. Request or provide information concerning activities of this contract or separate contracts to enable efficient sequencing.

### **3.5 SCHEDULING**

- A. Schedule the work to achieve Contract milestones and completion dates indicated.
- B. Deliver and install buildings to ensure that Project is completed on schedule. Calculate costs of weekend, overtime, or premium time work to accomplish the schedule and include these costs in the bid.

### **3.6 TRANSPORTING AND STORAGE**

- A. Transport prefabricated components from fabrication plant to Project site.
- B. Coordinate component delivery in time for erection in intended locations. Do not store components onsite prior to completion of foundations or site preparation.



### **3.7 ERECTION STEM FOUNDATIONS AND SLABS**

- A. General: Verify elevations and perform excavation required for foundations, footings, etc. prior to installation of foundation materials.
- B. Prepare formwork, embedments, and reinforcements, and place concrete as specified by modular contractor's engineer.
- C. Finish, cure, and patch concrete as specified by modular contractor's engineer. Coordinate all sitework with site contractor.

### **3.8 ERECTION GENERAL**

- A. Erection shall be performed by personnel experienced in the delivery and erection of modular and relocatable structures. All building joints shall be capable of being rigidly connected in order to maintain positive alignment of floors, walls, and roofs.
- B. Verify that floor slab and placed anchors are in correct position.
- C. All work shall be installed plumb, level, true to line and plane, in strict conformance as specified by modular contractor's engineer.
- D. Erect framing in accordance with AISC Specification for Structural Steel Buildings.
- E. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing.
- F. Set column base plates with non-shrink grout to achieve full plate bearing.
- G. Do not field cut or alter structural members without approval.
- H. Install bolts as indicated on shop drawings. Provide washers under all nuts. Draw up all nuts tightly. Install high-strength bolting in accordance with prevailing code.
- I. After erection, prime welds, abrasions, and surfaces not shop primed.

### **3.9 INSTALLATION ACCESSORIES**

- A. Install components and accessories as specified in their respective Sections and in accordance with modular manufacturer's instructions.
- B. Install trims and finishes neatly, free of gaps, holes, cut edges, frays, or ravel. Conceal fasteners wherever possible.
- C. Seal wall and roof accessories watertight and weather tight with sealant.

### **3.10 FIELD QUALITY CONTROL**

- A. Onsite inspection shall be performed by the Owner's site inspector. All work performed at the site shall be subject to the inspection of the site inspector. Inform the site inspector as to progress of work and dates when sitework will occur.
- B. Coordinate inspections with those required for other contracts, to the greatest extent feasible.

- C. Grounding tests of building electrical systems are to be observed and reported by the onsite inspector. Costs of inspection will be provided by the District.

### **3.11 TOLERANCES**

- A. Framing Members: 1/8 inch from level; 1/8 inch in ten feet (10') non-cumulative, from plumb.
- B. Siding and Roofing: 1/8 inch from true position.
- C. Other Elements: As specified in the respective related Sections.

### **3.12 PROTECTION**

- A. Repair or replace damaged work prior to acceptance.

### **3.13 ADJUSTING AND CLEANING**

- A. Prior to Project Architect's punch list, adjust work for complete and functional operation and appearance.
- B. Following punch list, perform all adjustments as noted by the Project Architect and maintain the work in this condition until acceptance by the Owner.

### **3.14 DEMONSTRATION**

- A. Demonstrate proper operation of all building elements and features to Project Architect and Owner.

### **3.15 MAINTENANCE**

- A. Provide extra materials for Owner's use in maintenance as specified in the pertinent related Sections.
- B. Fasteners and Connectors: Provide a minimum of five percent (5%) additional fasteners over the amount required for each connection of each module and panel of building component. Pack, label, and identify fasteners for intended use and store on the site in a mutually accepted, secure location. Deliver these surplus fasteners prior to the delivery of building modules to the site.

**END OF SECTION 13 34 23**

## **SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- D. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

#### **1.2 SUMMARY**

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Phased Construction:
  - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
  - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
  - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

#### **1.3 QUALITY ASSURANCE**

- A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.
- B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations,

nationally accepted codes. The installation of the sprinkler system(s) shall be performed by licensed personnel, licensed by the state of Texas.

- C. Equipment and installation to meet requirements of NFPA 13, latest edition and local authority having jurisdiction. All materials and distribution, and utilization equipment shall be UL Listed.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture.
- E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

#### **1.4 QUALIFICATION OF CONTRACTORS**

- A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.
- B. An approved contractor for the work under this division shall be:
  - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
  - 2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
  - 3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

#### **1.5 DESIGN STANDARDS**

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
  - 1. The International Fire Prevention Code
  - 2. The International Building Code
  - 3. National Fire Protection Association (NFPA) Standards:
    - a. NFPA 101 - Life Safety Code
    - b. NFPA 13 - Installation of Sprinkler Systems
    - c. NFPA 14 - Installation of Standpipe and Hose Systems
    - d. NFPA 20 - Installation of Centrifugal Fire Pumps
    - e. NFPA 24 - Installation of Private Fire Service Mains
    - f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
    - g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems
- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

## 1.6 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

## 1.7 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.
- E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
  - 1. Access Panels
  - 2. Floor, Wall, and Ceiling Plates
  - 3. Insulation
  - 4. Heat trace
  - 5. Piping and Equipment Identification
  - 6. Painting

## 1.8 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

## 1.9 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

#### **1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS**

- A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.
- B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.
- C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

#### **1.11 SUBSTITUTIONS**

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.

- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **ten (10)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
  - 1. Product data, drawings and descriptions of products, fabrication and installation procedures.
  - 2. Samples, where applicable or requested.
  - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
  - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
  - 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
  - 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
  - 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
  - 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution
- F. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the



Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

## 1.12 SUBMITTALS

- A. Provide shop drawings, hydraulic calculations and complete product data of entire sprinkler system as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
  - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
  - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
  - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
  - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

**1.13 CLOSEOUT SUBMITTALS**

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

**1.14 INTERFERENCE DRAWINGS**

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

**1.15 EXISTING CONDITIONS**

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
  - 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
  - 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
  - 2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
  - 3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its

function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.

4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

#### **1.16 EQUIPMENT, MATERIALS, BID BASIS**

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

- B. Unless “approved equal” is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as “base” products.
- C. “Equal product” and “approved equal” items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

#### **1.17 PRECONSTRUCTION CONFERENCE**

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

#### **1.18 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION**

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. All materials stored at site shall be protected from damage and from inclement weather. All piping shall be protected to prevent contact with ground.
- D. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

#### **1.19 GUARANTEE**

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

## 1.20 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
1. Facilities with less than 300 sprinklers – 6 minimum
  2. Facilities with 300 to 1000 sprinklers – 12 minimum
  3. Facilities with over 1000 sprinklers – 24 minimum

## 1.21 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. Provide Architect with final approved shop drawings before starting installation. Include details of the sprinkler system showing sections, light fixtures, air conditioning, ducts, overhead grilles and a plan showing fire department connection(s), and other equipment to be used. Drawings shall bear the stamp of review of the local fire insurance rating organization having jurisdiction.
- C. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- D. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
1. Number of Copies: Submit one set of marked up record prints.
  2. Number of Copies: Submit copies of record Drawings:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one of file prints.
      - 2) Submit record digital data files and one sets of plots.
      - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
      - 2) Submit record digital data files and three sets of record digital data file plots.
      - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- E. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents
  2. Remove Engineer's seal, name, address and logo from drawings.
  3. Mark documents AS-BUILT DRAWINGS.
  4. Clearly indicate: DOCUMENT PRODUCED BY.
  5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
  6. Indicate exact location of all underground plumbing and flow line elevations.
  7. Indicate exact location of all underground mechanical piping and elevations.

8. Indicate exact location of all underground electrical raceways and elevations.
9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

#### **1.22 START-UP-SERVICE**

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

#### **1.23 OPERATING AND MAINTENANCE INSTRUCTIONS**

- A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:
  1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
  2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
  3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
  4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
  5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

#### **1.24 COMPLIANCE AND PROVISION OF OWNER REQUIREMENTS**

- A. It shall be provided and installed in the following manners listed below the minimum requirements by the Owner design standards and guidelines by Cy Fair ISD.
  1. Flow and pressure test shall be performed and verified, and the information shall be indicated in the shop drawings by the licensed Fire Protection Designer.

2. Ensure that FDC fire sprinkler control valves location does not intrude onto or overlap in sidewalk areas.
3. Center sprinkler heads in ceiling tiles.
4. Do not daylight drain valves and test ports onto sidewalks.
5. As-builts shall include hydraulic calculations for each zone, this information shall be easily readable at the risers. Provide testing and inspection report for each fire hydrant (flow test report) and back Flow device, obtain latest form from CFISD, test to be witnessed by CFISD Maintenance. CFISD technician shall witness ansul, fire alarm, fire sprinkler and fire hydrant tests.
6. **“Flex Head” flexible connections to sprinkler heads not allowed per CFISD Maintenance.**
7. Inspector test drain to discharge into floor sink or trench drain in a mechanical room. Inspector test drain is not allowed to daylight out of the building. Floor sink or trench drain to be designed to handle flow from inspector test drain when fully open.
8. Sprinkler Engineer to provide calculation for drains where inspectors test is to be installed to Fire Sprinkler contractor prior to plan review by HCFMO.
9. Saddle clamps are not allowed.
10. **No sprinkler branch tap connections, tees, cross outlets with female threaded or grooved couplings that require hole drilling of main piping will be allowed. No Victaulic 920 or 920N style mechanical tees or similar style tees will be allowed.**

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. All sprinkler system equipment is to be UL Listed or FM Approved.

### **2.2 ACCESS PANELS**

- A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.
- D. Access panels are not allowed in gypsum ceilings in public spaces.

### **2.3 FLOOR, WALL & CEILING PLATES**

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

## 2.4 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

## 2.5 INSULATION

- A. The following shall be insulated:
1. All fire suppression water piping above grade (outdoor).
  2. All fire suppression water piping above grade (un-condition space).
  3. Acceptable manufacturers (provide as required by the project Division 21 conditions):
    - a. Glass Fiber Pipe Insulation:
      - 1) Johns-Manville Micro-Lok AP-T
      - 2) Owens-Corning ASJ/SSL
      - 3) Knauf ASJ/SSL
    - b. Cellular Glass Insulation (Foamglass):
      - 1) Pittsburgh Corning
      - 2) Cell-U-Foam
    - c. Aluminum Jacketing:
      - 1) Childers
      - 2) Pabco
      - 3) RPR
    - d. Fiberglass Reinforcing Cloth Mesh:
      - 1) Perma Glass Mesh
      - 2) Alpha Glass Mesh
      - 3) Childers Chil-Glas
      - 4) Vimasco
    - e. Mastics and Adhesives
      - 1) Childers
      - 2) Foster
      - 3) Vimasco
      - 4) Armstong 520 Adhesive
    - f. Elastomeric Insulation:
      - 1) Armacell
    - g. Weather Resistant Coating:
      - 1) WB Armaflex Finish
    - h. Glass Fiber Blanket Insulation:
      - 1) Manville R-Series Microlite FSKL
      - 2) Owens-Corning eD75 or ED100 RKF
      - 3) Knauf 0.75 PCF FSK
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.



- E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
  2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
  3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades
    - a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
    - c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
  7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.
  2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- G. Field-Applied Jackets:
1. General: ASTM C 921, Type I, unless otherwise indicated.
  2. Foil and Paper Jacket: Not acceptable.
  3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
    - a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. PVC Jacket Color: White.
    - c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
    - d. Not to be used for outdoors.
  4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
    - a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
    - b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - c. Not to be used for outdoors.

5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
    - a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
    - b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
    - c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.
  6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Accessories and Attachments
1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.
- I. Vapor Retardants
1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

## 2.6 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- F. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- G. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- H. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- I. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot.

- J. All piping shall be insulated with 1" thick fiberglass insulation.
- K. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- L. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

## **2.7 PIPING SYSTEMS IDENTIFICATION**

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:
  - 1. All above ground fire protection standpipe and sprinkler piping
  - 2. All above ground sprinkler drainage piping
- B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
  - 1. Sprinkler piping
  - 2. Dry Sprinkler piping
  - 3. Drain piping
  - 4. FDC piping
- C. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- D. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- E. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems. All valves on pumps shall be similar to the valve tags specified above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.
- F. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- G. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

## **2.8 EQUIPMENT LABELING**

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.

1. Permanently attached plastic laminate signs with 1" high lettering.
2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

## **2.9 PAINTING**

- A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.
- B. All piping exposed to corrosive environment such as pool areas, pool equipment room, sanitization room, and acid room shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect
- C. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Per CFISD Maintenance, pre-installation meeting required prior to starting sprinkler pipe installation.

### **3.2 INSTALLATION**

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. Ensure that FDC fire sprinkler control valve(s) location does not intrude onto nor overlap any sidewalk areas.
- F. Contractor shall coordinate with other trades so that drain valves and test ports do not terminate onto sidewalks.

- G. Inspector test drain shall not be permitted to drain to daylight out of the building.
- H. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- I. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.
- J. Pipe any fire equipment drainage into nearest approved drain fixture (floor sink or trench drain as indicated on plans) in Fire Riser or Mechanical rooms.
- K. Post Indicator Valve (PIV):
  - 1. Any above ground assembly shall have landscaping around components.
- L. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- M. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- N. Provide a pressure gauge at the top level of all standpipes.
- O. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- P. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- Q. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- R. Provide basket type metal guards (ThreadGUARD 201686) over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.
- S. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- T. Building shall be 100 percent fully sprinklered.
- U. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- V. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

- W. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- X. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- Y. Provide protection in all gymnasium areas.
- Z. Low voltage wiring to vault shall be underground and installed in PVC SCH 40 piping.
- AA. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

### 3.3 PREPARATION

- A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

### 3.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals

such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.
- H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.
- L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

### **3.5 CLEANING**

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

### **3.6 DEMONSTRATION**

- A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.
- B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.
- C. Provide testing and inspection report for each fire hydrant (flow test report) and backflow device. Obtain latest form from CFISD, test to be witnessed by CFISD maintenance. CFISD technician shall witness ansul, fire alarm, fire sprinkler and fire

hydrant tests. Testing of the completed sprinkler system shall be coordinated with CFISD and the Authority Having Jurisdiction.

- D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. As-builts shall include hydraulic calculations for each zone, this information shall be easily readable at the risers. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.
- E. Complete set of as-built drawings (Per NFPA ) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.
- F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.
- G. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 13 at time of acceptance of test.
- H. Inspections test to be piped into nearest drain to support flow.

### **3.7 PAINTING**

- A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.
- B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

### **3.8 WORKMANSHIP**

- A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.
- B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.
- C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.
- D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.
- E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

### **3.9 ERECTION AND INSTALLATION**



- A. Installation and workmanship requirements are specified hereinafter.
- B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

### 3.10 TESTS

- A. Prior to fire alarm test, fire sprinkler system installation shall be complete and flow and tamper devices tied into fire alarm panel.
- B. Notify owner 48 hours prior to any test. Owner may elect to observe or provide representative.
- C. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- D. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- E. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- F. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- G. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

### 3.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
  - 1. Provide the training during the Owner's regular working day.
  - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
  - 1. Minimum of 8 hours dedicated instructor time.
  - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
  - 1. One copy to the Owner.
  - 2. One copy to the Architect/Engineer.

- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each "Operation and Maintenance Manual":

### 3.12 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
  - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
  - 2. Format:
    - a. Size: 8-1/2" x 11"
    - b. Text: Manufacturer's printed data or neatly typewritten
  - 3. Drawings:
    - a. Provide reinforced punched binder tab and bind in text.
    - b. Fold larger drawings to size of text pages.
  - 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
  - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
    - a. Title of Project
    - b. Identity of separate structures as applicable.
    - c. Identity of general subject matter covered in the manual
  - 6. Binder as specified.
- B. Content of Manual:
  - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
    - a. Contractor, name of responsible principal, address and telephone number.
    - b. A list of each product required to be included, indexed to content of the volume.
    - c. List with each product, name, address and telephone number of:
      - 1) Subcontractor or installer
      - 2) Maintenance contractor as appropriate.
      - 3) Identify area of responsibility of each
      - 4) Local source of supply for parts and replacement
    - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
  - 2. Product Data:

- a. Include those sheets pertinent to the specific product.
  - b. Annotate each sheet to:
    - 1) Identify specific product or part installed.
    - 2) Identify data applicable to installation.
    - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
  3. Drawings:
    - a. Supplement product data with drawings as necessary to illustrate:
      - 1) Relations of component parts of equipment and systems.
      - 2) Control and flow diagrams.
    - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
    - c. Do not use Project Record Documents as maintenance drawings.
  4. Written text, as required to supplement product data for the particular installation:
    - a. Organize in consistent format under separate headings for different procedures.
    - b. Provide logical sequence of instructions for each procedure.
  5. Copy of each warranty, bond and service contract issued.
    - a. Provide information sheet for Owner's personnel, giving:
      - 1) Proper procedures in event of failure.
      - 2) Instances that might affect validity of warranties or bonds
  6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
    - a. Description of unit and component parts
      - 1) Function, normal operating characteristics, and limiting conditions.
      - 2) Performance curves, engineering data and tests.
      - 3) Complete nomenclature and commercial number of replaceable parts
    - b. Operating procedures:
      - 1) Start up, break-in, routine and normal operating instructions.
      - 2) Regulation, control, stopping, shut down and emergency instructions.
      - 3) Summer and winter operating instructions.
      - 4) Special operating instructions
    - c. Maintenance procedures:
      - 1) Routine operations
      - 2) Guide to trouble-shooting.
      - 3) Disassembly, repair and reassembly.
      - 4) Alignment, adjusting and checking.
      - 5) Routine service based on operating hours.
    - d. Servicing and lubrication schedule. List of lubricants required.
    - e. Manufacturer's printed operating and maintenance instructions.
    - f. Description of sequence of operation by control manufacturer
    - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      - 1) Predicted life of part subject to wear.
      - 2) Items recommended to be stocked as spare parts.
    - h. As installed control diagrams by controls manufacturer.
    - i. Complete equipment internal wiring diagrams.
    - j. Each Contractor's coordination drawings.
    - k. As installed color coded piping diagrams.
    - l. Charts of valve tag number, with location and function of each valve.
    - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
    - n. Other data as required under pertinent sections of the specifications.
  2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.
10. Provide a printed sheet giving brief instructions relative to all necessary aspects of sprinkler controls and emergency procedures next to sprinkler riser mains. Instruction sheet shall be protected by glass or a transparent plastic cover.

**END OF SECTION 21 05 00**

## **SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 DESCRIPTION**

- A. This section describes the following:
  - 1. Hangers, supports and anchors for the fire protection equipment, tanks and piping systems.
  - 2. Supplementary steel for support or attachment of fire protection tanks, equipment and piping to general construction elements of the project.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- D. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

#### **1.3 REFERENCES**

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. Code of Federal Regulations 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).
- C. National Fire Protection Association (NFPA):
  - 1. NFPA-13 Installation of Sprinkler Systems.
  - 2. NFPA-14 Installation of Standpipe and Hose Systems.
- D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA):  
  
Seismic Restraint Manual: Guidelines for Mechanical Systems - latest edition for the support of ductwork.
- E. UL Fire Resistance Directory, latest edition.

#### **1.4 SUMMARY**

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.
- B. Section Includes:
  - 1. Pipe, duct, and equipment hangers and supports.
  - 2. Anchors, equipment bases and supports.
  - 3. Sleeves and seals.
  - 4. Flashing, counter flashing and pipe stacks.
  - 5. Firestopping.

#### **1.5 DEFINITIONS**

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

#### **1.6 SUBMITTALS**

- A. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Shop Drawings:
  - 1. Indicate layout of piping systems, including equipment, critical dimensions and sizes.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
  - 2. Firestopping: Submit preparation and installation instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Submit calculations showing compliance with Division 01 Section "Lateral Force Procedures" for seismic bracing of ductwork and piping.

#### **1.7 QUALITY ASSURANCE**

- A. Comply with Division 21 Section "Common Results for Fire Suppression."
- B. Supports for Sprinkler Piping: Comply with NFPA 13.
- C. Supports for Standpipes: Comply with NFPA 14.
- A. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

- B. Do not use black steel devices, components, fasteners, etc. within the Clean Room interstitial space or in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.
- C. One (1) year warranty for all products and equipment from date of substantial completion.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect pipe from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system. Do not lay pipe on ground, use protective blocking to avoid contact with ground.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

## **1.9 ENVIRONMENTAL REQUIREMENTS**

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

## **PART 2 - PRODUCTS**

### **2.1 PIPE HANGERS AND SUPPORTS**

- A. Manufacturers:
  - 1. Unistrut Corp.
  - 2. B-Line Systems.
  - 3. Grinnell.
  - 4. Superstrut,
  - 5. Anvil.
- B. Pipe Supports:
  - 1. Conform to MSS SP58.
  - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.
  - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, black or galvanized, adjustable, Split-ring hangers per NFPA, UL listed.
  - 4. Multiple or Trapeze Hangers: 12 gauge (2.67 mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and; cast iron roll and stand for hot pipe sizes 6 inches and over.
  - 5. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12 gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping and adjustable steel yoke and cast iron roll for hot-pipe sizes 6 inches and over.

6. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.
7. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
8. Floor Support for Hot Pipe Sizes 6 Inches (152.4 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
10. CPVC Tube Support: CTS sized hangers or supports free of sharp edges.
11. **Saddle clamps shall not be permitted per CFISD Maintenance.**

## 2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

## 2.3 ATTACHMENT TO STRUCTURE

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. Connection to Existing Concrete Structure: Concrete anchors conforming to Division 03 Section "Concrete Accessories".
- C. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.
- D. For Support on New Concrete: Galvanized steel headed bolts.
- E. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.
- F. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

## 2.4 SUPORTS, BRACING, AND ACCESSORIES

- A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.
- B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.
- C. Sheet Metal Screws: Plated, size 10 minimum.
- D. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.



## **2.5 MECHANICAL SLEEVE SEALS**

- A. Manufacturers:
  - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## **2.6 FORMED STEEL CHANNEL**

- A. Manufacturers:
  - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## **2.7 FIRESTOPPING**

- A. Manufacturers:
  - 1. Dow Corning Corp. Model.
  - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
  - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
  - 2. Foam Firestopping Compounds: Multiple component foam compound.
  - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
  - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
  - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
  - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
  - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

## **2.8 FIRESTOPPING ACCESSORIES**

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
  - 1. Mineral fiberboard.
  - 2. Mineral fiber matting.
  - 3. Sheet metal.

4. Plywood or particle board.
  5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
  2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
  2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Per CFISD Maintenance, pre-installation meeting required prior to starting sprinkler pipe installation.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- C. Remove incompatible materials affecting bond.
- D. Install backing or damming materials to arrest liquid material leakage.
- E. Do not drill or cut structural members.
- F. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- G. Do not attach beam clamp on to bottom of steel joist.

#### **3.2 INSTALLATION - INSERTS**

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### **3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS**

- A. Install in accordance with MSS SP 58.
- B. Place hangers within 12 inches of each horizontal elbow.
- C. Use hangers with 1-1/2 inch minimum vertical adjustment.
- D. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
- E. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- F. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- K. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

### **3.4 INSTALLATION - SLEEVES**

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

### **3.5 INSTALLATION - FIRESTOPPING**

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
  
- D. Fire Rated Surface:
  - 1. Seal opening at floor and wall as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Pack void with backing material.
    - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
  
- E. Non-Rated Surfaces:
  - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
    - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Install type of sealant or caulk suitable for application.
  - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
  - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

**END OF SECTION 21 05 29**

## **SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS
- F. Manufacturers:
  - 1. Mason Industries
  - 2. Kinetics Noise Control
  - 3. Amber / Booth
  - 4. Vibration Eliminator
  - 5. Korfund
  - 6. Metraflex

#### **1.2 DEFINITIONS**

- A. IBC: International Building Code.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. Vibration and noise from all equipment shall be eliminated to the point that it is not noticeable in occupied areas.
- C. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- D. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.

- E. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.
- F. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.
- G. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- H. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs./sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- I. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- J. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- K. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- L. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
  - 1. Offices
    - a. Executive: 30
    - b. Conference rooms: 30
    - c. Private: 35
    - d. Open-plan areas: 35
    - e. Computer/business machine areas: 40
    - f. Public circulation: 40
  - 2. Schools
    - a. Lecture and classrooms: 30
    - b. Open-plan classrooms: 35
  - 3. Libraries: 25
  - 4. Theaters
    - a. Theater: 25
    - b. Stage house: 25
    - c. Trap room: 25
    - d. Orchestra pit: 25
    - e. Rehearsal rooms: 25
    - f. Teaching studios: 30
    - g. Practice rooms: 30

- h. Ensemble rooms: 30
- i. Shop: 45

#### **1.4 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.
- H. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. All fire suppression systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.
- E. Contractor shall verify isolators are adjusted properly and function properly.
- F. Contractor shall verify pump bases are sloped properly to eliminate ponding of condensate and/or water.

## **PART 2 - PRODUCTS**

### **2.1 VIBRATION ISOLATOR TYPES**

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.
- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the



hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.
- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

## 2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
  - 1. Base shall be sufficiently rigid to prevent misalignment or undue stress on pumps.

- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
  - 1. Base shall be sufficiently rigid to prevent misalignment or undue stress on pumps.
  
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
  - 1. Base shall be sufficiently rigid to prevent misalignment or undue stress on pumps.

### **2.3 FLEXIBLE PIPE CONNECTIONS**

- A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

### **2.4 MECHANICAL ANCHOR BOLTS**

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### **2.5 ADHESIVE ANCHOR BOLTS**

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless

steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Per CFISD Maintenance, pre-installation meeting required prior to starting sprinkler pipe installation.
- C. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PIPING ISOLATION**

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

### 3.3 INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in the relevant Division 33 section.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. CFISD and CFISD maintenance shall be notified 48 hours prior to test and may elect to witness testing.
- C. Perform tests and inspections.
- D. Tests and Inspections:
  1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  5. Test to 90 percent of rated proof load of device.
  6. Measure isolator restraint clearance.
  7. Measure isolator deflection.
  8. Verify snubber minimum clearances.
- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.

### **3.5 ADJUSTING**

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

**END OF SECTION 21 05 48.13**

## **SECTION 21 11 13 - FIRE SUPPRESSION SYSTEMS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

#### **1.2 GENERAL REQUIREMENTS**

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- E. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.
- F. *Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.*
- G. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

### 1.3 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.

### 1.4 SYSTEMS

- A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
  - 1. Pipes, fittings, and specialties
  - 2. Standpipe systems
  - 3. Automatic Sprinkler Systems
  - 4. Combination Standpipe/Automatic Sprinkler Risers
  - 5. Fire Department Valve Cabinets

### 1.5 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of substantial completion. This guarantee shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

### 1.6 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
  - 1. The International Fire Prevention Code
  - 2. The International Building Code
  - 3. National Fire Protection Association (NFPA) Standards:
    - a. NFPA 101 - Life Safety Code
    - b. NFPA 13 - Installation of Sprinkler Systems
    - c. NFPA 14 - Installation of Standpipe and Hose Systems
    - d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
- B. Factory Mutual (FM) Approval Guide

- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

## 1.7 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

## 1.8 DESIGN CRITERIA

- A. Any design documents issued to the contractor are for information only. The Contractor shall be responsible for all code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. The Contractor shall arrange for, and conduct a flow test and coordinate its validity with the Authorities Having Jurisdiction.
- B. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to Owner, through Architect, and the Engineer for confirmation of the existing water service.
- C. Where pre-design of the sprinkler system is required for submission for the building permit: The Fire Protection documents were prepared to be in compliance with all applicable codes and flow test data provided. The Contractor shall review all documents provided and report any modifications required to these documents to the Design Engineer during the shop drawing preparation stage.
- D. All sprinkler heads in occupied areas are to be fast response type heads (155 degrees – 165 degrees Fahrenheit).
- E. All occupied, heated spaces will be protected by wet sprinkler systems.
- F. Inspector test valves will be protected by wet sprinkler systems.
- G. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
  - 1. NFPA 13 Systems



Area/ Usage	Hazard Classification	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Public Spaces, Lobbies, Corridors, Offices, Restaurants, Lounges, Meeting Rooms	Light	.10	1,500 sq. ft.	225 sq. ft.	100 gpm
Mechanical Rooms, Electrical Rooms, Elevator Equipment Rooms, Maintenance/ Storage Rooms, Kitchen/ Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm
Ballrooms, exterior loading docks (see NFPA 13-A5.3.2)	Ordinary Group 2	.20	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe Systems: Parking Garages, Non- heated Attic Spaces, Ceiling Spaces, Porte Cochere and other spaces containing sprinkler piping that do not have alternate provisions to guarantee a 40° F temperature.	Ordinary Group 1	.15	1,950 sq. ft.	130 sq. ft.	250 gpm

- H. Available fire-hydrant flow test records indicate the following conditions:
1. Date: (MM/DD/YYYY) **02/16/2023**
  2. Time: **11:40 AM**
  3. Performed by: **Roger Straight of Allied Fire Protection**
  4. Location of Testing: **22602 Hempstead Hwy**
  5. Static Pressure: **75 PSI**
  6. Measured Flow: **1256 GPM**
  7. Residual Pressure: **25 PSI**
  8. **Note:** Mud District is West Harris County Mud 15 and the individual noted on the flow test is Oscar Mariscal
  9. **Note:** The flow test residual pressure is thought to be low due to a valve that may be partially closed. The mud district shall be coordinated with to provide a valve survey. Flow test shall be re-performed for the hydraulic calculations by the licensed Fire Sprinkler Designer.
- I. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.
- J. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.
- K. Coordination:
1. The Fire Protection Contractor shall review the complete set of project documents and coordinate his work with all other trades involved.

2. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Locations of sidewall heads shall be coordinated with architectural interior elevations.
  3. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, and ductwork.
- L. Sprinkler Systems
1. Any design documents issued to the Contractor are for information only. The Contractor shall be responsible for the actual layouts, general routing of piping and additional sprinkler heads to meet all requirements.
- M. All underground mains and appurtenances are to be installed according to NFPA 24.
- N. Combination Standpipe/Automatic Sprinkler Risers
1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-1/2" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
  2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
  3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.
  4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
  5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.
- O. Fire Protection System Alarms
1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
  2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
  3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
  4. Upright automatic sprinklers will be provided in all elevator shafts and elevator machine rooms. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

### **1.9 EQUIPMENT, MATERIALS, BID BASIS**

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- E. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

### **1.10 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION**

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. All materials stored at site shall be protected from damage and from inclement weather. All piping shall be protected from contact with ground.
- D. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

### **1.11 PRECONSTRUCTION CONFERENCE**

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

## 1.12 SUBMITTALS

- A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.
- B. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.
- C. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:
  1. Fire department valves
  2. Sprinkler heads and accessories
  3. Siamese Fire Department connection
  4. Fire valve cabinets
  5. Test header
  6. Roof manifold
  7. Backflow preventer
  8. Cutting oil indicating compatibility with the CPVC sprinkler piping
- D. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:
  1. Pipe and fittings
  2. Valves
  3. Pipe supports
  4. Pipe accessories
  5. Pipe labels and valve tags
  6. Flow switches
  7. Tamper switches
- E. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
- F. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.
- G. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

- H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

### 1.13 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
1. Facilities with less than 300 sprinklers – 6 minimum
  2. Facilities with 300 to 1000 sprinklers – 12 minimum
  3. Facilities with over 1000 sprinklers – 24 minimum
  4. Contractor shall provide and install a baked enamel steel box to store up to 36 heads.
  5. Contractor shall provide minimum six (6) of each type of head used.
  6. Contractor shall provide minimum six (6) additional sprinkler head wire guards (ThreadGUARD 201686).
  7. Contractor shall provide minimum one (1) sprinkler wrench.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. All sprinkler system equipment is to be UL Listed or FM Approved.
- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- C. Manufacturers.
1. Pipe.
    - a. American Tube
    - b. Wheatland Tube
    - c. Allied Tube & Conduit
  2. Mechanical Coupling Manufacturer
    - a. Victaulic
    - b. Grinnell
  3. Sprinkler Heads
    - a. Reliable
    - b. Grinnell
    - c. Viking
  4. Alarm Valves
    - a. Reliable
    - b. Grinnell
    - c. Viking
    - d. Simplex
  5. Valve
    - a. NIBCO
    - b. Grinnell
    - c. Stockham
    - d. Victaulic
  6. Specialty Valve (and Fire Department Connection)
    - a. Potter-Roemer
    - b. Elkhart Brass
    - c. Reliable
- D. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc.,

List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.

- E. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.
- F. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

## 2.2 MATERIALS

- A. All piping shall be made in the USA and be labeled according to City and /or State manufacturers. Pipe shall be protected with MIC shield coating.
- B. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.
- C. Pipe and Fittings:
  - 1. Piping – Schedule 40 ASTM A-53, A-795, A-135, black steel threaded piping and fittings for 2" and smaller. Schedule 40 ASTM A-53, A-795, A-135, black steel pipe with a cut groove ends, joined with mechanical coupling and cut groove cast iron fittings on piping 2-1/2" and greater in size.
    - a. Piping (piping only, excluding fittings) for dry systems shall be Schedule 40 ASTM 53 galvanized steel in all pipe sizes, screwed galvanized cast or malleable iron fittings through 2", grooved couplings for 2-1/2" and larger pipe sizes.
    - b. Buried Water Service Entrance Piping shall be Ames riser
  - 2. Grooved Couplings & Fittings: ductile iron with gasket and two bolts, 300 psi working pressure. Victaulic, Grinnell fittings.
  - 3. Flanges – cast iron, 175 pound S.W.P., with threaded inlet, or Victaulic Mod. #741.
  - 4. Hangers to meet NFPA 13 spacing and type.
  - 5. **Sprinkler branch tap connections, tees, cross outlets with female threaded or grooved couplings that require hole drilling of main piping shall be not permitted per CFISD Maintenance.**
  - 6. Victaulic 920 and 920N style mechanical tees or similar style tees shall not be permitted per CFISD Maintenance.
- D. Control Valves: All control valves are to be electrically supervised. A pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
  - 1. 2 inches and smaller – 175 psi, bronze, rising stem, inside screw, solid wedge, UL listed and FM approved, Victaulic with built-in tamper switches.
  - 2. 2-1/2 inches and larger – 175 psi, iron body, bronze trim, rising stem, OS&Y, solid wedge, UL listed and FM approved, Victaulic with tamper switch.
  - 3. All butterfly valves shall have a built in tamper resistant switch for supervision of the open position. The switch shall be contained within a NEMA Type 1, general purpose indoor rated housing. Either unauthorized removal of the switch housing (when the valve is open) or closing the valve, shall cause the switch contacts to change position. The switch shall have four conductors to accommodate connections to Style 4 or Style 6 signaling line circuit devices.

- E. Check Valves:
1. Check valves 2-1/2 inches and larger shall be iron body swing check with cast brass hinge, rod, non-slam type and brass faced discs.
  2. Check valves 2 inches and smaller shall be UL listed brass body and all brass fitted, non-slam type.
- F. Alarm Check Valves: Shall be for vertical installation, cast iron, complete with retard chamberport to alarm, pressure gauges, main drain, electric alarm pressure switch with dual contacts suitable for either open or closed circuit.
1. Control valve, check valve, and pressure or flow switch tied to fire alarm system and sprinkler electric alarm bell.
    - a. 2-1/2" to 3, Class 150, iron body, bronze disc, flanged or groove ends, Victaulic, UL Listed for fire service. Or provide equivalent by Nibco, Grinnell or Stockham.
    - b. 4" and larger, Class 150, iron body, bronze trim, flanged ends, Victaulic, flanged, UL Listed for fire service. Or provide equivalent by Nibco, Grinnell or Stockham.
  2. Provide approved automatic sprinkler valve with one or two pole (as required) flow detectors, pressure switch, outside electric alarm bell. Refer to "Water Motor Gong" section for gong requirements.
- G. Switches:
1. Water Flow Switches: Shall be paddle type water flow alarm (or pressure switch of retard chamber) and with double contacts for either open or closed circuit operation for connection to building fire alarm system.
  2. Tamper Switches: Shall be designed as an integral part of control valve assembly or tamper switch shall have double acting, spring loaded plunger to activate a single-pole double-throw switch for valve supervision of OS&Y type control valves.
- H. Fire Department Connections (as indicated on plans):
1. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
  2. Free Standing: Potter Roemer 5760 series or approved equal.
- I. Sprinkler Head Escutcheons.
1. Finish for all escutcheons shall match the finish of sprinkler heads on which they are used. Use white cover plates of recessed sprinkler heads.
- J. Water Motor Gong
1. 24V alarm bell to be 10" round red enamel steel bell with electrically operated vibrating outdoor alarm, UL Listed, red enamel steel, manufactured by Simplex, or approved equal. Bell may be 120V only with CFISD approval. Contractor shall coordinate with Div 26 for electrical connection.
- K. Fire Valve Cabinet
1. 1810 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve with cap and chain; 1810-10 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve, 2-1/2" x 1-1/2" Reducer and 1-1/2" Cap.

2. Cabinet shall be 20-gauge steel with polyester coating, recessed with flush full metal hinged door with cam catch and integral shelf for fire extinguisher. Cabinet shall be Potter-Roemer 1810 series or approved equal.

L. Roof Manifold

1. Wall mount manifold to be three outlet horizontal configuration, cast brass body with threaded 2-1/2" male outlets complete with valves, chains and caps, rough brass finish. Provide accessible indicating type shut off valve with supervisory switch (normally closed) and automatic ball drip to roof. Roof manifold to be Potter-Roemer 5880 series or approved equal.

### 2.3 STAND PIPES

- A. Provide a complete stand pipe system where indicated with 2 1/2" fire hose connections in compliance with Authority Having Jurisdiction Fire Marshal's requirements for the entire building with separate stand-pipes at auditorium stage and entrance to the auditorium.

1. Building system shall provide a 2 1/2" fire hose connection at each landing of each egress stairwell and additional connections throughout the facility in order to provide complete fire hose coverage based on a 150 foot of hose with 50 foot of water spray. Locate fire hose connections in Fire Marshal and Architect approved locations such as stairwells and mechanical rooms and provide required signage. Contractor shall include stand pipe water flow requirements in hydraulic calculation for sizing of all fire water main piping and fire pump. Contractor shall include in submittal a plan showing location of all fire hose connections for approval by Authority Having Jurisdiction Fire Marshal prior to fabrication and rough-in. System shall also comply with NFPA 13 for hose connections for fire department use.
2. Provide a complete stand pipe system on each side of the auditorium stage.
3. Provide a complete stand pipe system on each side of the entrance to the auditorium.

### 2.4 AUTOMATIC SPRINKLER SYSTEM MATERIALS

- A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.

- B. Automatic sprinklers shall be provided as follows:

C. Public Spaces with Gypsum and Lay-in Ceilings

1. Fully concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Ceiling coverplate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Reliable, Grinnell or Viking Horizon Mirage concealed sprinkler or approved equal.
2. Small frame glass element, semi-recessed, quick response pendent sprinklers shall be provided in all areas with lay-in ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Sprinkler and escutcheon to be white finish. Sprinkler to be Reliable, Grinnell or Viking Microfast Model M series with Model E-1 escutcheon.

D. Back-of-House Spaces and Unfinished Spaces with no Ceiling

1. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless conditions require



higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Reliable, Grinnell or Viking Microfast Model M.

- E. Kitchen Coolers and Freezers
  - 1. Standard response semi-recessed chrome plated dry pendent sprinklers with fusible solder type sprinklers and UL listed heavy duty mechanically fastened sprinkler guards (ThreadGUARD 201686) will be provided in all coolers and freezers. Barrel length shall be a minimum of 12" from the base of the tee to the top of the freezer. Sprinkler and escutcheon shall be polished chrome finish. Sprinkler shall be Reliable, Grinnell or Viking Model M.
- F. Exterior Overhangs and Elevator Shafts
  - 1. Standard response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Reliable, Grinnell or Viking Model M.
- G. All outdoor sprinkler heads shall be wax coated.
- H. UL listed heavy duty mechanically fastened sprinkler guards (ThreadGUARD 201686) shall be installed on all sprinklers 7'-0" or less above floor, cafeteria, gym, and all locations where sprinklers are not recessed in tile ceiling.
- I. Provide sprinklers at the highest and lowest level of all stairwells.
- J. Provide sidewall sprinklers at the top end and bottom of all elevator hoistways. Sprinklers may be omitted from traction elevators on non-combustible elevator shafts and cabs which meet the requirements of ASME A.17.1 and where acceptable to the local authorities.
- K. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.
- L. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.
- M. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.
- N. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.
- O. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.

- P. Provide sprinkler connections to all required food service hood suppression systems.
- Q. Exposed Area Type: Standard upright type with chrome plated finish.
- R. Temperature rating on fusible links to suit specific hazard area with minimum margin of safety 50 degrees F (lead type only).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Per CFISD Maintenance, pre-installation meeting required prior to starting sprinkler pipe installation.

#### 3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. Install valves with stems upright or horizontal, not inverted.
- C. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- D. **“Flex Head” flexible connections to sprinkler heads shall not be permitted per CFISD Maintenance.**
- E. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- F. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- G. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- H. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles. For every sprinkler head, tap main/branch pipe serving each individual sprinkler head shall come from the top of pipe to prevent trash from collecting at head. **(Piping laterals to a sprinkler head is FORBIDDEN off the bottom of the main or lateral piping system).**

- I. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- J. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- K. Dry pipe systems shall be specified as installed with the longitudinal weld seam located above the horizontal centerline of the pipe, and with drain valves installed at all low points regardless of trapped water volume. Require that mains and branch lines be pitched at least 1/2 in. per 10 ft in all locations, including in non-refrigerated areas (areas not subject to freezing).
- L. Provide a pressure gauge at the top level of all standpipes.
- M. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- N. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- O. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- P. UL listed heavy duty mechanically fastened sprinkler guards (ThreadGUARD 201686) over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, gymnasium areas, storage rooms and all unfinished areas where the head is less than 7 feet-0 inches above finished floor.
- Q. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- R. Building shall be 100 percent fully sprinklered.
- S. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- T. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- U. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.

### **3.3 CLEANING**

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.

- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

### **3.4 TESTS**

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- B. Contractor shall notify CFISD and CFISD maintenance 48 hours prior of any testing and the district or district's representative may elect to witness testing.
- C. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- D. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- E. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- F. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

**END OF SECTION 21 11 13**

## **SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Phased Construction:
  - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational
  - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
  - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

#### **1.3 QUALITY ASSURANCE**

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture and comply with the Buy America Act.
- D. Defective insulation (mildewed, peeled, cracked, blistered or showing signs of condensation on exterior surface) shall be replaced.
- E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

- F. An approved contractor for the work under this division shall be:
  - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
  - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 5 years.

#### **1.4 WORK INCLUDED**

- A. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
  - 1. Domestic cold, hot and hot water recirculation systems
  - 2. Sanitary, drainage, waste and vent systems
  - 3. Natural gas/propane gas system
  - 4. Primary and emergency storm drainage systems
  - 5. Grease waste and waste systems from food service areas
- B. Contract quality control including workmanship, manufacturer's instructions, and demonstrations.

#### **1.5 COMPLETE PERFORMANCE OF WORK**

- A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.
- B. Provide all rigging required for complete installation and furnish drawings showing necessary points of support, reactions and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.
- C. Become thoroughly acquainted with the work involved, obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this division necessary for the proper installation of their contracts. Confer with other Contractors for finish adjacent to work of this section and arrange to have visible portions of the work (such as access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architects.
- D. Transmit to trades doing work of other sections all information required for work to be provided under their respective sections (such as fresh water connections, foundations, electric wiring, access doors, and the like) in ample time for installation.
- E. Where disagreements occur between the plans and the specifications, or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Base Bid.

#### **1.6 COORDINATION WITH OTHER TRADES**

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

## 1.7 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

## 1.8 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **ten (10)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and



complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:

1. Product data, drawings and descriptions of products, fabrication and installation procedures.
2. Samples, where applicable or requested.
3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
6. Cost information, including a proposal of the net change, if any in the Contract Sum.
7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.
9. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

## **1.9 SUBMITTALS**

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing

per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.

- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
  2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
  3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
  4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

#### 1.10 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

#### 1.11 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.

- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

#### 1.12 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
  - 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
  - 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
  - 2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
  - 3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
  - 4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The

- General Contractor shall maintain barricades separating work area from occupied areas.
5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
  6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
  7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
  8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
  9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
  10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
  11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
  12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
  13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
  14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

### **1.13 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Deliver insulation, coverings, cements, adhesives and coatings to site in unopened containers with manufacturer's stamp, clearly labeled with flame and smoke rating, affixed showing fire hazard indices of products.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.
- E. Do not install damaged or wet insulation; remove immediately from project site. Fiberglass insulation that has been wet, whether dried or not, is considered damaged.

#### 1.14 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

#### 1.15 AS BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- A. As Built Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
  - 1. Number of Copies: Submit one set of marked up record prints.
  - 2. Number of Copies: Submit copies of record Drawings:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one of file prints.
      - 2) Submit record digital data files and one sets of plots.
      - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
      - 2) Submit record digital data files and three sets of record digital data file plots.
      - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. As-Built drawings should indicate the following information as a minimum:
  - 1. Indicate all addendum changes to documents.
  - 2. Remove Engineer's seal, name, address and logo from drawings.
  - 3. Mark documents AS-BUILT DRAWINGS.
  - 4. Clearly indicate: DOCUMENT PRODUCED BY.
  - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
  - 6. Indicate exact location of all underground plumbing and flow line elevations.
  - 7. Indicate exact location of all underground mechanical piping and elevations.
  - 8. Indicate exact location of all underground electrical raceways and elevations.

9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

#### **1.16 START-UP-SERVICE**

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

#### **1.17 COORDINATION OF TRADES**

- A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.
- F. Work that is installed under this Contract which interferes with the architectural design or building structure, shall be removed and relocated as required at no additional cost to the Contract.
- G. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his

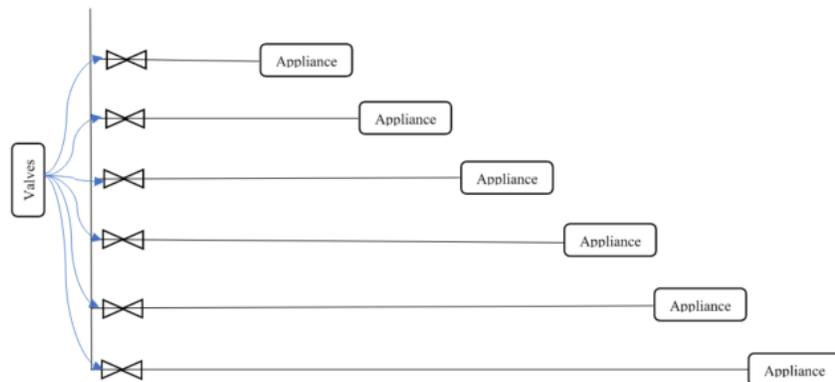
work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions.

### 1.18 WARRANTY

- A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.
- B. Defects shall include, but not limited to, the following:
  - 1. Mildewing
  - 2. Peeling, cracking and blistering
  - 3. Condensation on exterior surfaces
- C. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of substantial completion. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

### 1.19 COMPLIANCE AND PROVISION OF OWNER REQUIREMENTS

- A. It shall be provided and installed in the following manners listed below the minimum requirements by the Owner design standards and guidelines by Cy Fair ISD.
  - 1. Water isolation valves are to be installed at every supply pipe to each restroom. No valve shall be located above a hard ceiling. Deviation from this required prior CFISD approval AND the use of a 24"x24" access panel directly below the valve.
  - 2. All cleanouts are to be in accessible locations.
  - 3. For new kitchens and kitchen remodels, provide American Standard "Lucerne" hand sinks (do not use American Standard "Wheelchair" lavatory in kitchens as hand sinks).
  - 4. Provide any control panels, electric motors, safety devices and control wiring as required for the proper operation of electrical systems associated with plumbing equipment being installed.
  - 5. For new kitchens and remodeled kitchens: DO NOT supply the kitchen with tempered water. Supply kitchen with 140 degree water and use point-of-use mixing valves at each fixture requiring ASSE 1070 thermostatic mixing valve.
  - 6. Gas piping in kitchens shall be installed as a manifold with all valves for appliances located at the end of the wall. See Diagram 1:



- a.
  - 7. Provide separate trenches for water lines, sanitary and gas piping.
  - 8. All horizontal waste piping in chases serving one or more toilets shall have a wall clean-out on top of the 4" sanitary tee.
  - 9. Foreign pipe and fittings are unacceptable.

10. All figure 5 fittings, cross fittings and double combination fittings in chases shall have a clean-out on top of the fitting.
11. Piping shall be labeled along entire length indicating size, class, material specification, manufacturers name and country of origin.
12. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
13. All supply lines to fixtures shall be flared at end device attachment points.
14. For hot water circulation loops into lavatory chase for multiple lavatories, provide valved by-pass in corridor. Provide additional valves on the loop for hot water entering the restroom and leaving restroom.
15. Provide an eyewash to central plant area adjacent to, or close to, the water treatment station.

## **PART 2 – PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.
- B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.
- D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.
- F. All pipe penetrations through walls and concrete floors shall be fire rated.

### **2.2 ACCESS PANELS**

- A. Group valves together above suspended ceilings, walls, furred spaces to avoid use of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Valves installed above hard ceiling shall not be permitted per CFISD maintenance— deviation from this requires prior CFISD approval and the use of a 24"x24" access panel directly below the valve.
  1. Coordinate size and location of access panel with Architect.
- C. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed. All cleanouts shall be in accessible locations.
- D. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver



operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

- E. Access panels are not allowed in gypsum ceilings in public spaces.

## 2.3 INSULATION

- A. Materials as specified in this section shall be manufactured by:
  - 1. Armstrong
  - 2. CertainTeed
  - 3. Pittsburg-Corning
  - 4. Owens-Corning
  - 5. Schuller
  - 6. Knauf
  - 7. Johns Manville
  - 8. Benjamin Foster
  - 9. Childers
- B. Insulation thicknesses minimum requirements shall be as shown in the table below. Where different thickness is required by code or local jurisdiction, more stringent standard shall be used.
- C. The following shall be insulated:
  - 1. Only domestic cold water (DCW) piping exposed to freezing temperatures, including exterior walls and eight (5) feet horizontally in plenum from exterior wall.
    - a. Maintain insulation for domestic hot and cold water in mechanical rooms and in central plants.
  - 2. Make-up water.
  - 3. All domestic hot water (DHW) and domestic hot water return (DHWR) piping except at horizontal chase branch piping to individual plumbing fixtures.
  - 4. All horizontal and vertical storm drain piping and roof drain bodies inside of building above slab. (RD and ORD included)
  - 5. All water piping exposed to areas subject to freezing, refer to "Heat Cable for Freeze Protection of Piping" under Part 2.4 of Section 22 05 00 for additional requirements.
  - 6. NOTE:
    - a. All pipes larger than one (1) inch shall use closed cell insulation at saddles.
    - b. All joints and seams shall be sealed vapor tight.
    - c. All seams and staples shall then be covered with "All Service Jacket" three-inch wide tape.
    - d. Insulate exposed piping.
- D. Domestic Water Piping (Interior):
  - 1. Provide 4 lb. density sectional fiberglass pipe insulation with white all service jackets, sealing lap joint and vapor barrier. Thermal conductivity not to exceed 0.24
- E. Domestic Water Piping (Exterior):
  - 1. Provide elastomeric cellular thermal, or preformed phenolic foam pipe insulation with secured metal jacketing.
- F. Drain Bodies and Down Spouts:

1. Insulate horizontal and vertical roof drain down spouts, underside of roof drain bodies, chilled water waste lines from fixture/equipment (i.e. drinking fountain or ice machine) to junction with main waste stacks, and branch lines including traps and exposed underside of floor drains receiving cooling coil condensate—same as water piping where exposed to building occupant view.
  - a. Provide 4 lb. density sectional fiberglass pipe insulation with white all service jackets, sealing lap joint and vapor barrier. Thermal conductivity not to exceed 0.24
  - b. When concealed, insulation shall be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab.

Piping System Types (PLUMBING)	Fluid Temperature Range		Insulation Thickness for Pipe Sizes				
	°C	°F	1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
Domestic Cold Water	Ambient	Ambient	0.5	1.0	1.0	1.0	--
Domestic Cold Water <i>(Interior, exposed to freezing temperatures)</i>	Ambient	Ambient	1.0	1.5	1.5	1.5	
Domestic Cold Water <i>(Exterior, exposed)</i>	Ambient	Ambient	1.5	2.0	2.0	2.0	
Domestic Hot Water & Hot Water Recirculation	43-71	110-160	1.0	1.5	1.5	1.5	--
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	1.0	1.5	1.5	2.0	--
Hori & Vert Storm Drainage <i>(Concealed, blanket wrap)</i>	Ambient	Ambient	--	--	1.5	1.5	1.5
Hori & Vert Storm Drainage <i>(Exposed, rigid w/ all service jackets)</i>	Ambient	Ambient	--	--	1.0	1.0	1.0

- G. Aluminum Jacket:
  1. Jacket for piping shall be 0.016 inch thick type 3105 aluminum with factory applied one mil polykraft moisture barrier
  2. Preformed fitting covers for all elbows and tees shall be factory made 0.024 inch type 1100 aluminum to match pipe covering.
  3. Aluminum jacketing shall be provided for all exposed piping.
  4. Only accepted manufacturer:
    - a. Childers "Strap-On"

**2.4 HEAT CABLE FOR FREEZE PROTECTION OF PIPING**

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Manufacturers:
  1. Emerson-Chromalox
  2. Pyrotenax
  3. Briscoe
  4. Raychem

5. Thermon

- C. Provide a complete system of self-regulating heating cable on all domestic water piping in crawl spaces, un-conditioned attic spaces and outdoors and any other locations subject to freezing. System shall be UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- D. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- E. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- F. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- G. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- H. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- I. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- J. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot. Heat trace shall operate at 120 volts, A.C., without the use of transformers. Provide quantity of 120 volt branch circuits as required to serve heat trace load, maximum 1800 watts per circuit.
- K. All piping shall be insulated with 1" thick fiberglass insulation.
- L. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- M. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

**2.5 HEAT CABLE FOR TEMPERATURE MAINTENANCE OF PIPING**

- A. Provide electric heat tracing on all domestic hot water piping to maintain the temperature of the water in the piping that is downstream of the hot water loop up to within 24" of the fixtures being served to meet all the mandates of the Green Code per the local AHJ.
- B. Manufacturers:
  - 1. Emerson-Chromalox
  - 2. Pyrotenax

3. Briscoe
  4. Raychem
- C. Provide a complete system of self-regulating heating cable on all domestic hot water piping that is non-circulated. System shall be UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to maintain water temperature.
  - D. Electric heat cable shall be installed linearly along the top of the pipe when passing through pipe hangers and at the 4 or 8 o'clock position on linear runs and not compressed or pinched between two objects and allowance shall be made for all fittings, valves, pipe supports, etc. Penetrations through fire rated assemblies shall have its own sleeve sealed with fire resistant material equal to STI firestop. Attach the cable to the pipe every two feet with RAYCHEM AT-180 pipe tape. Cable shall be installed prior to insulation of the piping and after all testing of the hot water system is complete.
  - E. Electric cable shall be capable of maintaining a minimum water temperature of 105 degrees F and a maximum temperature of 140 degrees F, at an ambient air temperature of 50 degrees F.
  - F. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
  - G. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 100 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
  - H. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
  - I. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
  - J. Electric heating cable shall be Raychem HWAT-R2 or approved equal. Heat trace shall operate at 208 or 277 volts, A.C., without the use of transformers. Provide quantity of 208 or 277 volt branch circuits as required to serve heat trace load.
  - K. All piping shall be insulated with minimum of 1" thick fiberglass insulation for piping up to 1" in diameter, for larger piping consult manufactures guidelines.
  - L. Heating-cable circuit shall be protected by an integral ground-fault system for the HWAT-ECO-GF AND ACS-30 control system, so no additional protection is required.
  - M. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide water temperature maintenance. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall consist of a complete system of RayClic connection kits with a complete circuit that requires a power connection, an end seal and HWAT-ECO-GF controller to ensure proper water temperature. Splices and tees and other connection kits are used as needed. Installation shall be as recommended by the manufacturer.

## 2.6 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.

- B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.
- C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

## 2.7 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

## 2.8 TRACER WIRE

- A. General:
  - 1. All trace wire and trace wire products shall be domestically manufactured in the U.S.A.
  - 2. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.
  - 3. All trace wire shall be provided for mains 4" and larger.
    - a. Wire shall be installed in the trench on top of the underground plastic piping and then attached to metal pipe above slab at the end of the run. The wire shall extend max 5'-0" outside the building to an access point, refer to Termination/Access for specified box.
      - 1) Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.
- B. Trace wire: (Copper clad Steel (CCS) trace wire)
  - 1. Open-Trench Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core soft drawn tracer wire, 250# average tensile break load, 30 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1230-SF, or approved equal.
  - 2. Directional Bore or Jacked Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1245-HS, or approved equal.
- C. Connectors: (Copper clad Steel (CCS) trace wire)
  - 1. Splices along the continuous run of trace wire for repair of a wire break or replacement of failed segment of wire shall use 3M Brand DBR Direct Bury Splice Kit or approved equal. Approved alternatives must securely connect two or more wires, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.
  - 2. Branch connections for laterals, turnouts, services and appurtenances shall use DryConn Direct Bury Lug Aqua, or approved equal. Approved alternatives must securely connect one or two wires to the main trace wire without cutting the main trace wire, effectively moisture seal by means of a dielectric non-hardening

silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.

- a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the resulting tone continues for that part of the associated segment of the underground system.
  3. Non-locking, friction fit, twist-on or taped connectors are not acceptable. Twisting of copper wiring is not acceptable.
- D. Termination/Access: (Copper clad Steel (CCS) trace wire)
1. Terminal box (otherwise known as a terminal "well") shall be located at five (5) feet outside the building to terminate the tracer wire. Provide SnakePit Access Point by Copperhead Industries or equivalent product by alternative manufacturer that is compatible with the completed tracer wire system.
  2. Terminal box, or "fink box", shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.
  3. Terminal Box shall consist of tubular housing, terminal board and removable round lid.
  4. Minimum dimensions shall be 5-1/2" diameter and 8" high. Base shall be sized to fit 4" schedule 40 PVC pipe.
  5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of construction shall be impervious to chemicals typically used for snow and ice removal and pavement and hardscape maintenance.
  6. Housing and lid shall be designed for service
    - a. Turf and landscape areas
      - 1) Light duty housing with plastic lid
    - b. Hardscape areas
      - 1) Heavy duty housing with cast iron or ductile iron lid
    - c. Roadway, driveway and parking lot applications not allowed
  7. Terminal board shall have nickel plated brass terminals. Number of terminals shall be as required for specific installation with four spare terminals, minimum.
- E. Grounding: (Copper clad Steel (CCS) trace wire)
1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
  2. Drive in Magnesium Anode: Copperhead Part # ANO-1005 (1.5 lb).

## 2.9 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings.

## 2.10 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
1. Domestic hot, cold and hot water recirculation water piping
  2. Gas piping
  3. Storm drainage piping

4. Overflow storm drainage piping
  5. Sanitary, waste and vent piping
  6. Non-potable water piping
- B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.
1. Identification on piping shall indicate:
    - a. Size
    - b. System
    - c. Class
    - d. Material Specification
    - e. Manufacturers Name
    - f. Country of Origin
- C. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.
- D. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- E. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- F. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems.
- G. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- H. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

## **2.11 EQUIPMENT LABELING**

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
1. Permanently attached plastic laminate signs with 1" high lettering.
  2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

## **PART 3 - EXECUTION**

### **3.1 OWNER INSTRUCTION - GENERAL**

- A. Contractor shall notify Owner, through Architect, of all pre-installation meetings as per CFISD Construction Standards.

- B. Provide on-site Owner training for all new equipment by factory trained specialists.
- C. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- D. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- E. No retainage shall be released until Owner has received all Operations and Maintenance manuals and as-built drawings and first O&M walk.
- F. Refer to individual equipment specifications for additional training requirements.
- G. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.
- H. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.
- I. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- J. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

### **3.2 INSTRUCTION OF OWNER'S PERSONNEL**

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
  - 1. Provide the training during the Owner's regular working day.
  - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
  - 1. Minimum of 8 hours dedicated instructor time.
  - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
  - 1. One copy to the Owner.
  - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing,



maintenance, and shut down of each item of equipment.

- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each "Operation and Maintenance Manual":

### **3.3 GENERAL REQUIREMENTS**

- A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.
- B. Separate trenches for water lines, sanitary and gas piping.
- C. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.
- D. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- E. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

### **3.4 STORAGE AND PROTECTION OF MATERIALS**

- A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until final connection to system is made.
- C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with covers by Sioux Chief, Zurn or the followings.

1. Floor sink opening – Cover with heavy duty plywood or heavy-duty plastic cover by SmartGuard (using duct tape is not acceptable).
  2. Floor drain – Plastic cover by SmartGuard, Mifab allstar or equal (using duct tape is not acceptable).
  3. Pipe – Plastic cover by SmartGuard or equal (using duct tape is not acceptable).
  4. Fixtures – Provide plastic cover until final punch.
  5. Clean-out top - Mifab allstar or equal (using duct tape is not acceptable)
- D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.
- E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.
- F. All materials stored at site shall be protected from damage and from inclement weather. All piping shall be protected to prevent contact with ground.
- G. Piping and fittings resting on ground is unacceptable. Contractor shall keep products covered and provide temporary end caps/closures on pipes and fittings.

### **3.5 REMOVAL OF MATERIALS**

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involves.
- C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.
- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas

or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

- E. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.
- F. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and operational maintenance of all electrical services for the new and existing facilities, The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- G. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- H. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction

### **3.6 EXCAVATION, TRENCHING & BACKFILLING**

- A. The Contractor shall perform all excavation to install the work herein specified and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling or boring shall be done except under pavement.
- B. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped in 12" layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.
- C. The Contractor shall coordinate and provide pipe supports as required per structural drawings for any void form system, exiting the building or special requirements on backfill.
- D. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's

installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be identified as to the type of line per ANSI standard nomenclature and color.

1. Stabilized sand shall not be permitted for use on sanitary sewer lines.

- E. The trenches shall be backfilled with cement stabilized sand materials approved for backfilling, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of material.
  1. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.
    - a. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
    - b. Determine minimum cement content from production data and statistical history. Provide no less than 1.1 sacks of cement per ton of dry sand.
  2. Cement: Type I Portland cement conforming to ASTM C 150.
  3. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank sand below, and the following requirements:
    - a. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
    - b. Deleterious materials:
      - 1) Clay lumps, ASTM C 142 - less than 0.5 percent.
      - 2) Lightweight pieces, ASTM C 123; less than 5.0 percent.
      - 3) Organic impurities, ASTM C 40, color no darker than standard color.
      - 4) Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
  4. Stabilized sand shall not be permitted for use on sanitary sewer lines.
- F. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.
- G. Tracer wires shall be installed adjacent to nonmetallic underground water, gas and main sewage lines under the building pad and stubbed up into a ground test well enclosure so that the tracer can connect to it. Tracer wire shall be color coded; yellow for natural gas; green for storm and sanitary sewer; and blue for potable water.
  1. Installation:
    - a. Trace wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all trace wire access points.
    - b. Except for approved spliced-in repair or replacement connections, tracer wire shall be continuous and without splices from each trace wire access point.

- c. The tracer wire system shall be installed as a continuous single wire. No looping or coiling of wire is allowed.
- d. Prior to backfill, install tracer wire on top of pipe and secure in place with ties or hitches at maximum 10-foot intervals in accordance with the Water Utilities Manual. Run tracer wire continuously along pipe and terminate in access points. Only adjacent valve boxes are acceptable access points. Where buried splices occur, use an electrical splicing kit 3M Brand DBR Direct Bury Splice Kit, or AGENCY approved equal. Provide no less than 24 inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.
- e. At the point of connection between existing conductive pipes, the tracer wire shall not be connected to the iron pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved waterproof connection to a grounding anode, buried at the same depth as the tracer wire. All such connection points shall be grounded.
- f. Where existing tracer wire is encountered on an existing utility that is being extended or tied into, the new and existing tracer wire shall be connected using approved splice connectors, shall be properly grounded at the splice location as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
- g. Tracer wire shall be laid flat and securely affixed to the pipe at the three o'clock position. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At service saddles, the tracer wire shall not be allowed to be placed between the saddle and the main.
- h. At all main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured to the cap for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the main. The tracer wire from the end cap shall be brought to a surface into test station box within the public right-of-way for future access.
- i. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar.
- j. At the point of connection between ductile iron water mains, with any non iron main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of one quarter inch (1/4") thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.
- k. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- l. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- m. Open trench method:
  - 1) Tracer wire shall be placed a minimum of 8 inches above buried natural gas piping and nonmetallic piping for any service. For

- other utility piping systems tracer wire shall be laid directly upon pipe and attached at 8-10 ft. intervals with non-conductive tape. Additional attachment shall be provided at offsets and fittings in piping system. Tracer wire shall be placed carefully and great care shall be exercised during backfilling operations to maintain physical integrity and position relative to piping.
- 2) Splices in tracer wire shall be kept to an absolute minimum. When splices are necessary they shall be made with tracer wire connectors as specified above. Other splicing methods not allowed.
- n. Directional drilling method:
    - 1) Two tracer wires shall be provided with one wire as backup.
    - 2) Tracer wires shall be pulled through bore hole in conjunction with utility pipe. Wires shall be located on opposite sides of utility pipe.
    - 3) Tracer wire splices are not allowed in drilled sections.
  - o. Tracer wires shall be interconnected at intersections of mainlines and branches utilizing single three-way connector at each point of connection.
  - p. At a minimum, a terminal box shall be provided at each building utility service entrance and shall be located above piping within 5 ft. of point of entry into building.
  - q. Terminal boxes shall be located no greater than 1,000 linear feet of developed pipe length apart.
  - r. Terminal boxes shall not be located in streets, drives, parking lots or other areas subject to vehicular traffic. Terminal boxes shall not be located in areas where access to box is impeded.
  - s. Terminal boxes shall be installed flush with finished grade and centered in grade level concrete pad. Concrete pad shall be 18" by 18" minimum and shall be 6" thick.
  - t. PVC pipe riser shall be firmly attached to bottom of terminal box housing and extended downward to an elevation approximately 12" above piping. Riser shall serve as a vertical conduit for guiding tracer wires into bottom of terminal box.
  - u. Care shall be taken to extend tracer wire from utility pipe to terminal box in an orderly manner as backfill is placed.
  - v. End of each tracer wire shall be properly landed on dedicated terminal within terminal box and securely tightened. 12-18" excess length shall be provided for each wire within box. Each terminal shall be clearly identified with permanent label. Where tracer wires for multiple utilities are terminated care shall be taken to ensure accuracy of identification at both ends.
2. Testing:
- a. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.
  - b. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
  - c. Final testing of each tracer wire shall be performed after backfill is complete and terminal boxes have been permanently installed and wires terminated. Test shall be witnessed by AE, Owner and CFISD maintenance—Contractor shall provide 48 hours notice of testing. It may be advisable for Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be

accomplished using typical low frequency line tracing equipment.  
Continuity testing in lieu of actual line tracing is not acceptable.

- H. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

### **3.7 CONCRETE WORK**

- A. Construct curbs, pads, vaults and similar supports for equipment where required.
- B. First floor and equipment yard: Provide minimum of 6" thick housekeeping pads at floor mounted equipment a minimum of 4" larger than the entire area occupied by equipment. The pads at the equipment yard must be elevated at 6" above finished floor (1st floor).
- C. Second floor and above: Provide 4" thick housekeeping pads at floor mounted equipment a minimum of 4" larger than the entire area occupied by equipment. Dowel pads to structural slab.
- D. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

### **3.8 CLEANING**

- A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, etc. shall be thoroughly cleaned both inside and out.
- C. After testing and balancing of systems as specified and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

### **3.9 TESTING OF PIPING SYSTEMS**

- A. General
  - 1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
  - 2. All tests shall be witnessed by the inspector having jurisdiction, the Owner, CFISD maintenance and CFISD Plumbing Technician—with a minimum 48-hour notice given these authorities.
  - 3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
  - 4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.
- B. Sanitary Piping Systems
  - 1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest

- opening in the section under test. All sections shall be tested with a minimum of 10 feet of head. In testing successive sections, at least the upper 10 feet of the next section shall be tested so that no joint of piping in the building shall be submitted to a test of less than 10 feet of head. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
  3. Exterior connections shall be tested as part of the interior systems.
- C. Interior Water Piping Systems
1. Upon completion of the entire water supply system or a section of it as required, it shall be tested prior to connection of fixtures and proved tight under a water/air pressure of 150 psi. Pressure shall hold for a period of one hour without introducing additional water/air. Water used for testing shall be from a potable source of supply. Defective joints or piping shall be replaced as required and all piping shall be retested.
- D. Exterior Water Piping System
1. All exterior domestic water piping shall be tested to 150 psi for a period of two hours.
- E. Defective Work
1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.
- F. Additional Tests
1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection. The engineer and owner shall be notified to observe a smoke test of the system.
  2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
  3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.
  4. Refer to 22 20 23 – GAS PIPING for additional testing on gas system(s).

### **3.10 DISINFECTION OF WATER SYSTEM - INTERIOR AND EXTERIOR**

- A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.
- B. Whenever the authority having jurisdiction does not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or sodium hydrochloride solution, shall be introduced into the system and drawn to all points in the system. The disinfection solution shall be allowed to remain in the system for a period of eight hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be flushed from



the system with clear water until the residual chlorine content is not greater than 0.2 parts per million.

- C. This work is to be supervised or performed by an approved chemical testing laboratory and results sent to Engineer or his representative for verification.

### 3.11 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
  2. Format:
    - a. Size: 8-1/2" x 11".
    - b. Text: Manufacturer's printed data or neatly typewritten
  3. Drawings:
    - a. Provide reinforced punched binder tab and bind in text.
    - b. Fold larger drawings to size of text pages.
  4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
  5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
    - a. Title of Project
    - b. Identity of separate structures as applicable.
    - c. Identity of general subject matter covered in the manual
  6. Binder as specified.
- B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
    - a. Contractor, name of responsible principal, address and telephone number.
    - b. A list of each product required to be included, indexed to content of the volume.
    - c. List with each product, name, address and telephone number of:
      - 1) Subcontractor or installer
      - 2) Maintenance contractor as appropriate.
      - 3) Identify area of responsibility of each
      - 4) Local source of supply for parts and replacement
    - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
  2. Product Data:
    - a. Include those sheets pertinent to the specific product.
    - b. Annotate each sheet to:
      - 1) Identify specific product or part installed.
      - 2) Identify data applicable to installation.
      - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
  3. Drawings:
    - a. Supplement product data with drawings as necessary to illustrate:
      - 1) Relations of component parts of equipment and systems.
      - 2) Control and flow diagrams.
    - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
    - c. Do not use Project Record Documents as maintenance drawings.
  4. Written text, as required to supplement product data for the particular installation:
    - a. Organize in consistent format under separate headings for different procedures.

- b. Provide logical sequence of instructions for each procedure.
  - 5. Copy of each warranty, bond and service contract issued.
    - a. Provide information sheet for Owner's personnel, giving:
      - 1) Proper procedures in event of failure.
      - 2) Instances that might affect validity of warranties or bonds
  - 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
- 1. Content for each unit of equipment and system as appropriate:
    - a. Description of unit and component parts
      - 1) Function, normal operating characteristics, and limiting conditions.
      - 2) Performance curves, engineering data and tests.
      - 3) Complete nomenclature and commercial number of replaceable parts
    - b. Operating procedures:
      - 1) Start up, break-in, routine and normal operating instructions.
      - 2) Regulation, control, stopping, shut down and emergency instructions.
      - 3) Summer and winter operating instructions.
      - 4) Special operating instructions
    - c. Maintenance procedures:
      - 1) Routine operations
      - 2) Guide to trouble-shooting.
      - 3) Disassembly, repair and reassembly.
      - 4) Alignment, adjusting and checking.
      - 5) Routine service based on operating hours.
    - d. Servicing and lubrication schedule. List of lubricants required.
    - e. Manufacturer's printed operating and maintenance instructions.
    - f. Description of sequence of operation by control manufacturer
    - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      - 1) Predicted life of part subject to wear.
      - 2) Items recommended to be stocked as spare parts.
    - h. As installed control diagrams by controls manufacturer.
    - i. Complete equipment internal wiring diagrams.
    - j. Each Contractor's coordination drawings.
    - k. As installed color coded piping diagrams.
    - l. Charts of valve tag number, with location and function of each valve.
    - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
    - n. Other data as required under pertinent sections of the specifications.
  - 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
  - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
  - 4. Provide complete information for products specified in Division 23.
  - 5. Provide certificates of compliance as specified in each related section.
  - 6. Provide start up reports as specified in each related section.
  - 7. Provide signed receipts for spare parts and material.
  - 8. Provide training report and certificates.
  - 9. Provide backflow preventer certified test reports.
  - 10. Provide gas piping pressure test report.

**END OF SECTION 22 05 00**

## **SECTION 22 05 10 – SANITARY PIPE TESTING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Acceptance testing of sanitary sewers including:
  - 1. Visual inspection of sewer pipes.
  - 2. Leakage testing of sewer pipes.
  - 3. Leakage testing of manholes/sampling well/interceptor.
  - 4. Television and Video Inspection.
- B. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

#### **1.3 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
  - 2. Refer to related Section - Measurement and Payment for unit price procedures

#### **1.4 REFERENCES**

- A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.
- B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.
- F. ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

#### **1.5 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Project Manager. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- D. Manufacturer's Installation Instructions: Submit special procedures.
- E. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

#### **1.7 QUALITY ASSURANCE**

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between cleanouts and pipe junctions.
- B. Must meet Texas Commission on Environmental Quality (TCEQ) Testing Requirements Chapter-217-57.
- C. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspection as directed by Project Manager.
- E. Upon completion of tape reviews by Project Manager, Contractor will be notified regarding final acceptance of sewer segment.

#### **1.8 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

#### **1.9 SEQUENCE AND SCHEDULING**

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Project Manager. Perform testing under observation of Project Manager.

### **1.10 WARRANTY**

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

## **PART 2 - PRODUCTS**

### **2.1 EXFILTRATION TEST**

- A. Backflow Preventer: Provide a transient Backflow Preventer to use when water for testing will be taken from building system. Conform to local code requirements for type of backflow preventer use.
- B. Test Equipment:
  - 1. Pipe plugs.
  - 2. Pipe risers with 10-foot head of water (clear marked).

### **2.2 LOW PRESSURE AIR TEST**

- A. Minimum Requirement for Equipment:
  - 1. Control panel.
  - 2. Low-pressure air supply connected to control panel.
  - 3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
  - 4. Air hoses from control panel to:
    - a. Air supply.
    - b. Pneumatic plugs.
    - c. Sealed line for pressuring.
    - d. Sealed line for monitoring internal pressure.
- B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

### **2.3 SMOKE TESTING**

- A. Equipment:
  - 1. Pneumatic plugs.
  - 2. Smoke generator as supplied by Superior Signal Company, or approved equal.
  - 3. Blowers producing 2500 scfm minimum.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps
- C. If a cleanout or check valve has not been installed at the easement/property line, the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation (within five feet of the foundation wall), then a cleanout

shall be installed. If the building lateral exits the foundation under an existing deck or concrete patio, the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner/Engineers.

### 3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

- A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and relay or replace pipe segment.
- B. Cut 10'-0" pipe section and inspect to determine the integrity of the pipe condition

### 3.3 LEAKAGE TESTING FOR GRAVITY SYSTEM PIPES

- A. For a gravity system pipe that will transport wastewater by gravity flow, test gravity sanitary sewer pipes for leakage by either exfiltration or with low pressure air testing.
- B. Compensating for Ground Water Pressure:
  - 1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
  - 2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.
- C. Drainage and Vent water test
  - 1. Determine ground water elevation.
  - 2. Plug sewer in downstream manhole, cleanout, vent, or floor as necessary.
  - 3. Plug incoming pipes in upstream manhole, cleanout, vent, or floor as necessary.
  - 4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 12 feet the test pipe.
  - 5. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot (3048 mm) head of water. In testing successive sections, at least the upper 10 feet (3048 mm) of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet (3048 mm) of the system, shall have been submitted to a test of less than a 10-foot (3048 mm) head of water. This pressure shall be held for not less than 15 minutes.
- D. Drainage and Vent air test.
  - 1. Determine ground water elevation.
  - 2. Plug sewer in downstream manhole, cleanout, vent, or floor as necessary.
  - 3. Plug incoming pipes in upstream manhole, cleanout, vent, or floor as necessary.
  - 4. Plastic piping shall not be tested using air. An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi (34.5 kPa) or sufficient to balance a 10-inch (254 mm) column of mercury. This pressure shall be held for a test period of not less than 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperatures or the seating of gaskets shall be made prior to the beginning of the test period.

- E. Drainage and vent final test.
  - 1. The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of local code. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column (248.8 Pa) shall be held for a test period of not less than 15 minutes.

### **3.4 AS-BUILT DRAWINGS**

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex, mylar film positives) and AutoCad 2000 files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
  - 1. Indicate all changes to documents
  - 2. Remove Engineer's seal, name, address and logo from drawings.
  - 3. Mark documents AS-BUILT DRAWINGS.
  - 4. Clearly indicate: DOCUMENT PRODUCED BY.
  - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
  - 6. Indicate exact location of all underground plumbing and flow line elevations.
  - 7. Indicate exact location of all underground mechanical piping and elevations.
  - 8. Indicate exact location of all underground electrical raceways and elevations.
  - 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
  - 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.

**END OF SECTION 22 05 10**

## **SECTION 22 05 12 – WATER PIPE TESTING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Related Documents:
  - 1. Drawings and general provisions of the Subcontract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section includes:
  - 1. Visual inspection of pipes.
  - 2. Cleaning and flushing building piping systems.
  - 3. Testing building piping systems.
  - 4. Disinfecting building piping systems.
  - 5. Placing building piping systems in operation.
- C. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
  - 2. Refer to related Section - Measurement and Payment for unit price procedures

#### **1.3 REFERENCES**

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
  - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
  - 4. Refer to Division 22 Section "Common Results for Plumbing" for codes and standards, and other general requirements.
- B. Code of Federal Regulations (CFR):
  - 1. 29 CFR 1910 Occupational Safety and Health Standards (OSHA)
- C. American Water Works Association (AWWA):
  - 1. AWWA C601 Disinfecting Water Mains
- D. Compressed Gas Association (CGA):
  - 1. CGA G4.1 Cleaning Equipment for Oxygen Service
- E. Factory Mutual Engineering (FM):
  - 1. FM Factory Mutual System Loss Prevention Data Sheets



- F. International Association of Plumbing and Mechanical Officials (IAPMO):
  - 1. IAPMO UPC Uniform Plumbing Code

#### **1.4 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Project Manager. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- D. Manufacturer's Installation Instructions: Submit special procedures.
- E. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

#### **1.6 QUALITY ASSURANCE**

- A. Water to be discharged from flushing and disinfecting procedures shall be neutralized and disposed of in accordance with Division 01 Section "Special Procedures" or Division 33.
- B. The purpose of these procedures is to ensure that pressure tests are conducted safely and effectively. They cover pressure testing of new and existing pressure systems or components at a test pressure more than 0 psig. They apply to mechanics, supervisors, inspectors, custodians, and subcontractors responsible for pressure tests.
- C. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspection as directed by Project Manager.
- E. Upon completion of tape reviews by Project Manager, Contractor will be notified regarding final acceptance of sewer segment.

#### **1.7 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

### **1.8 SEQUENCE AND SCHEDULING**

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Project Manager. Perform testing under observation of Project Manager.

### **1.9 WARRANTY**

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

## **PART 2 – PRODUCTS**

### **2.1 GENERAL**

- A. Provide test equipment at the followings: Piping connection between pipe tested and water source; Equipment, materials, and facilities required to perform specified tests including but not limited to the following:
  - 1. Pumping equipment
  - 2. Calibrated water meter (within 6 months)
  - 3. Calibrated pressure gauges (within 6 months)
- B. Sectionalizing devices required including but not limited to the following:
  - 1. Flanges
  - 2. Valves
  - 3. Bulkheads
  - 4. Bracing
  - 5. Blocking

## **PART 3 - EXECUTION**

### **3.1 CLEANING AND FLUSHING**

- A. Water Piping Systems:
  - 1. After completion of all work in each section of the various water piping systems, and prior to testing, flush all piping to remove foreign material and to thoroughly clean the system. Flushing shall be continued until the water leaving the system is clear and acceptable to the Owner/Engineer, but in no case shall the flushing be performed for less than 10 minutes.
  - 2. Ensure that adequate quantities of water are available to produce a flushing velocity of not less than 2.5 fps (0.8 m/s).

### **3.2 HYDROSTATIC PRESSURE TEST**

- A. General:
  - 1. Prior to acceptance and initial operation, inspect and test the piping systems to ensure that the design, materials, fabrication, and installation are in accordance with these specifications.
  - 2. Test piping prior to being enclosed, covered-up, or treated externally with insulation, tape wrapping, mastic coating, and like treatments.

3. Notify the Owner/Engineer at least 48 hours prior to testing, and conduct tests in the presence of an owner's Representative.
  4. Piping systems shall show no pressure loss, unless noted otherwise, while being tested in accordance with this section of these specifications. When leakage or other defects are located, repair or replace the affected portion of the piping system and retest. In the event repairs, replacement, or additions are made following the pressure test, retest the affected piping. In the case of very minor repairs, replacement, or additions, the Owner/Engineer may, solely at its discretion, omit retesting provided precautionary measures are taken to assure sound construction.
- B. General Test Procedures:
1. All valves shall be in full-open position during the test. Do not include any components (gauges, relief valves, instrumentation, and like items) as part of the tests that are not rated for the testing pressure.
  2. Removes all persons not directly involved with the test from the immediate test area.
  3. Removes pressure relief valves or non-reclosing relief device from the vessel or test boundary where the test pressure will exceed the set pressure of the valve or Holds down each valve by means of an appropriate test clamp and pressurizes both sides of non-reclosing relief devices. Installs temporary, higher-rated devices where practical.
  4. Installs the calibrated test gauge so it is visible at all times.
  5. Pressurizes the system, raising the pressure in the system gradually until the designated test pressure is achieved.
  6. Do not attempt to modify a piping system when it is pressurized, including tightening leaking joints. Do not repair, replace, or retighten leaking joints or components until the pressure has been reduced to ambient level.
  7. Measure test pressure with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate the maximum test pressure. Record any pressure loss due to leakage during the pressure test period while the system is pressurized but isolated from the pressure source.
  8. In general, test nonhazardous liquid, inert gas, and compressed air system at a minimum of 150% of the working pressure in the line. The test pressure for each piping system shall be not less than the following values, irrespective of the design maximum allowable working pressure (MAWP):

TEST SYSTEM	TEST PRESSURE (Gauge)	TES MEDIA	TEST DURATION
DCW, DHW,	225 psi gauge (1553 kPa)	CW	24 hours

9. Prepare test records of inspection and all tests performed. Indicate which portions of the piping system are in accordance these specifications. Briefly document test procedures, instruments and media used, and test pressures. Before requesting final approval of a piping installation, submit copies of test records for Owner/Engineer approval.

### 3.3 DISINFECTING CW/HW PIPING SYSTEM

- A. General: Clean and disinfect all cold water systems in accordance with AWWA C601 when the project is complete and when, by test, the system is proven to be free from leaks and ready for use.

- B. Disinfecting Procedure:
1. Connect the injection hose to the test connection.
  2. With the system completely full of water and the supply valve open, proceed to adjust every valve of the system so that a trickle of water flows from each.
  3. Inject the disinfectant slowly, at a uniform rate, until an orthotolidine test at each outlet shows a minimum chlorine residual concentration of 100 parts per million (ppm).
  4. Close all outlets and valves, including the valve connecting to the water-supply line and the 3/4-inch (19-mm) service cock on the solution-injection connection.
  5. Maintain the condition for 24 hours. If after 24 hours, orthotolidine tests indicate that the chlorine residual concentration has decreased below 50 ppm, repeat the disinfecting procedure until an approved result is obtained.
  6. When the residual chlorine requirements have been fulfilled, the part of the water system being disinfected shall be drained and flushed until the chlorine concentration of the discharged water has been reduced to an amount equivalent to the level normally present in the water supplied to the area. This part of the system shall again be isolated by valving off. All drainage and flushing water shall be directed to the sanitary sewer system.
  7. After checking that the residual chlorine concentration is not greater than control levels using the orthotolidine test, the Contractor shall take water samples after a 24 hour incubation period at predetermined locations of the isolated system. The sampling points shall be chosen so as to provide accurate information regarding the bacteriological quality of the water. Before putting this system into service, the results of these tests must show the water to completely free (i.e., <1 or none detected) from coliform organisms after a 24 hour incubation period.
  8. If the results of the bacteriological tests do not meet the standard specified above, the disinfection procedures shall be repeated until this standard is satisfied.
  9. Tie-in fittings to be placed in existing mains shall be sterilized either by immersing in a chlorine solution of 500 ppm for one-half hour or by swabbing with five (5) percent hypochlorite solution.
  10. On system where a fire sprinkler riser is to be directly connected to an existing underground link that has been previously sterilized and terminates above ground, the double check valves, test cocks, and all pipe and fittings between the check valves and the termination of the underground line, are to be immersed in a 500 ppm chlorine solution for one (1) hour prior to assembly. The termination of the underground line is not to be left uncovered any longer than necessary. The sterilization process is to be monitored by LBNL EH&S Division or his representation and an Owner/Engineer Inspector.
  11. Bennett Marine Utility Inc. shall issue a Certification Sterilization / Chlorination to the subcontractor to demonstrate satisfactory completion of the above procedure. The subcontractor shall submit the Certification to LBNL for their review.
- C. Disinfecting Agent: The Subcontractor will supply the disinfecting agent and the injecting apparatus, will inject the disinfecting agent into the system, and operate the valves.
- D. Preparation:
1. Provide a test connection for the system to be disinfected within 2-3 feet (0.6-0.9 m) of its junction with the water supply lines, for injecting the disinfectant into the system.
  2. Prepare the water-flow valves for sterilization.
  3. Thoroughly flush the system by fully opening every outlet and operating every fixture until clear water flows from all of them.

### **3.4 DISINFECTING LCW or DI PIPING SYSTEM**

- A. Low Conductivity Water (LCW) or Deionized (DI) Water: After water system piping is installed and pressure tested, flush pipe with trisodium phosphate to remove any dirt, oil, and grease. After flushing, pump 3% hydrogen peroxide at 20 psig (138 Kpa), to flush clean. Rinse system with low conductivity water or deionized water after sterilization until all traces of chlorine are gone. Notify the LBL Project Manager 10 days prior to rinsing the system. It is the Contractor's responsibility to clean the piping system of all debris and visible contaminants. It is absolutely essential that the pipe system is free of any oil, grease, or other contaminants. Perform all of the above in the presence of the LBNL Project Manager or his representative.

### **3.5 PREPARATION**

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps
- C. If a cleanout or check valve has not been installed at the easement/property line, the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation (within five feet of the foundation wall), then a cleanout shall be installed. If the building lateral exits the foundation under an existing deck or concrete patio, the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner/Engineers.

### **3.6 AS-BUILT DRAWINGS**

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each (reproducible Dayrex, mylar film positives) and AutoCad 2000 files on disk (CD Rom).
- C. As-Built drawings should indicate the following information as a minimum:
  - 1. Indicate all changes to documents
  - 2. Remove Engineer's seal, name, address and logo from drawings.
  - 3. Mark documents AS-BUILT DRAWINGS.
  - 4. Clearly indicate: DOCUMENT PRODUCED BY.
  - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
  - 6. Indicate exact location of all underground plumbing and flow line elevations.
  - 7. Indicate exact location of all underground mechanical piping and elevations.
  - 8. Indicate exact location of all underground electrical raceways and elevations.
  - 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.

10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.

**END OF SECTION 22 05 12**

## **SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Expansion joints.
  - 2. Pipe alignment guides.
  - 3. Pipe anchors.
- B. Related Sections:
  - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.

#### **1.3 DESIGN REQUIREMENTS**

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
  - 1. Installation Temperature: 50 degrees Fahrenheit.
  - 2. Domestic Hot Water: 140 degrees Fahrenheit.
  - 3. Safety Factor: 30 percent.

#### **1.4 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer.
- C. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.

- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

### **1.6 QUALITY ASSURANCE**

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

### **1.7 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.
- C. All materials stored at site shall be protected from damage and from inclement weather. All piping shall be blocked to prevent contact with ground.

### **1.9 WARRANTY**

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

## **PART 2 - PRODUCTS**

### **2.1 EXPANSION JOINTS**

- A. Manufacturers:
  - 1. Amber / Booth
  - 2. Triplex
  - 3. Mason Industries
  - 4. Uponor
- B. Stainless Steel Bellows Type:
  - 1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
  - 2. Maximum Compression: 1-3/4 inch.



3. Maximum Extension: 1/4 inch.
  4. Joint: As specified for pipe joints.
  5. Size: Use pipe sized units
  6. Application: Steel piping three (3) inch and smaller.
- C. External Ring Controlled Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
  2. Maximum Compression: 15/16 inch.
  3. Maximum Extension: 5/16 inch.
  4. Maximum Offset: 1/8 inch.
  5. Joint: Flanged
  6. Size: Use pipe sized units
  7. Accessories: Internal flow liner.
  8. Application: Steel piping three (3) inch and larger.
- D. Double Sphere, Flexible Compensators:
1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
  2. Working Pressure: 215 psi
  3. Maximum Temperature: 250 degrees Fahrenheit.
  4. Maximum Compression: 1-1/4 inch through 6 inch pipe; 1-1/2 inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
  5. Maximum Elongation: 3/4 inch through 6 inch pipe; 1-1/2 inch 8 inch through 12 inch; 5/8 inch for 14 inch.
  6. Maximum Offset: 3/8 inch through 6 inch pipe; 7/8 inch 8 inch through 12 inch; 1 inch for 14 inch.
  7. Maximum Angular Movement: 15 degrees.
  8. Joint: Steel flanges or ductile iron pipe flanges.
  9. Size: Use pipe sized units
  10. Accessories: Control rods.
  11. Application: Steel piping two (2) inch and larger.

## 2.2 ACCESSORIES

- A. Manufacturers:
1. Amber / Booth
  2. Triplex
  3. Mason Industries
- B. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine piping layout and notify the Architects/Engineers of additional anchors or expansion joints required to adequately protect system.
- B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify that installation is in accordance with manufacturer's recommendations and that connectors are performing satisfactorily.

### **3.2 INSTALLATION**

- A. Install Work in accordance with ASME B31.9.
- B. Install piping to allow for expansion and Contraction without stressing pipe, joints or connected equipment.
- C. Flexible piping shall not be used in concealed spaces. Access panel shall be provided for concealed space installation.
- D. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.
- E. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- G. Provide expansion loops as per pipe manufacturers design guideline or as indicated on Drawings. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so that movement takes place along axis of pipe only. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.
- H. Coordinate with installation of piping seismic braces so they do not interfere with thermal expansion loop action or building joint loop action.

**END OF SECTION 22 05 16**

## **SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

#### **1.3 DEFINITIONS**

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
  - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

#### **1.6 ENVIRONMENTAL REQUIREMENTS**

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.

- C. Provide ventilation in areas to receive solvent cured materials.

## **PART 2 - PRODUCTS**

### **2.1 PIPE HANGERS AND SUPPORTS**

- A. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- B. Manufacturers:
  - 1. Unistrut Corp.
  - 2. Erico Caddy.
  - 3. PHP System.
  - 4. Anvil/Anvil Strut.
  - 5. BLINE.
- C. Pipe Supports:
  - 1. Conform to MSS SP58.
  - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
  - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
  - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
  - 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
  - 7. Vertical Support: Steel riser clamp.
  - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
  - 10. Galvanized steel to be used for outdoor installation.

### **2.2 ACCESSORIES**

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Provide locking nuts on all rod extensions.
- C. Galvanized steel to be used for outdoor installation.

### **2.3 INSERTS**

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

### **2.4 SLEEVES AND ESCUTCHEONS**

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.
- K. Sealant: Acrylic

## 2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
  - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected

with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## 2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
  - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## 2.7 FIRESTOPPING

- A. Manufacturers:
  - 1. Dow Corning Corp. Model.
  - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
  - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
  - 2. Foam Firestopping Compounds: Multiple component foam compound.
  - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
  - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
  - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
  - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
  - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

## 2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
  - 1. Mineral fiberboard.
  - 2. Mineral fiber matting.
  - 3. Sheet metal.
  - 4. Plywood or particle board.
  - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
  - 1. Furnish UL listed products or products tested by independent testing laboratory.

2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
  2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

#### **3.2 INSTALLATION - INSERTS**

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

#### **3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS**

- A. Install in accordance with MSS SP 58.
- B. Supports for Gas Piping:
  1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
  2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Place hangers within 12 inches of each horizontal elbow.

- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- L. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- M. All pipes larger than one (1) inch shall use closed cell insulation saddles.
- N. Saddle clamps shall not be permitted per CFISD design standards.**
- O. Clevis hangers to fit around outside of insulation with a one-foot section of rigid pipe insulation and galvanized pipe saddle. Hanger to be outside of the rigid insulation on the outside of the galvanized saddle. As per CFISD Standards.

### 3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

### 3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.



- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
  - 1. Seal opening at floor and wall as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Pack void with backing material.
    - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
  - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
    - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Install type of sealant or caulk suitable for application.
  - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
  - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

**END OF SECTION 22 05 29**

## **SECTION 22 05 48.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirements:
  - 1. Section 21 05 48.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
  - 2. Section 23 05 48.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.
- C. Manufacturers:
  - 1. Mason Industries
  - 2. Kinetics Noise Control
  - 3. Amber / Booth
  - 4. Vibration Eliminator
  - 5. Korfund
  - 6. Metraflex

#### **1.2 DEFINITIONS**

- A. IBC: International Building Code.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. Vibration and noise from all equipment shall be eliminated to the point that it is not noticeable in occupied areas.
- C. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- D. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.

- E. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.
- F. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.
- G. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- H. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- I. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- J. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- K. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- L. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
  - 1. Offices
    - a. Executive: 30
    - b. Conference rooms: 30
    - c. Private: 35
    - d. Open-plan areas: 35
    - e. Computer/business machine areas: 40
    - f. Public circulation: 40
  - 2. Schools
    - a. Lecture and classrooms: 30
    - b. Open-plan classrooms: 35
  - 3. Libraries: 25
  - 4. Theaters
    - a. Theater: 25
    - b. Stage house: 25
    - c. Trap room: 25
    - d. Orchestra pit: 25
    - e. Rehearsal rooms: 25
    - f. Teaching studios: 30
    - g. Practice rooms: 30
    - h. Ensemble rooms: 30
    - i. Shop: 45

#### **1.4 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.
- H. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. All Plumbing systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.
- E. Contractor shall verify isolators are adjusted properly and function properly.
- F. Contractor shall verify pump bases are sloped properly to eliminate ponding of condensate and/or water.

## **PART 2 - PRODUCTS**

### **2.1 VIBRATION ISOLATOR TYPES**

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.
- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

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- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.
- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

## 2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem.

Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

### **2.3 FLEXIBLE PIPE CONNECTIONS**

- A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

### **2.4 MECHANICAL ANCHOR BOLTS**

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### **2.5 ADHESIVE ANCHOR BOLTS**

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PIPING ISOLATION**

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

### **3.3 INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in the relevant Division 33 section.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.



- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and notify Owner of qualified testing agency.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.
  6. Measure isolator restraint clearance.
  7. Measure isolator deflection.
  8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.
- F. Notify Owner 48 hours prior to test. Test shall be witness by Owner or Owner's Representative (CFISD maintenance and plumbing technician).

### **3.5 ADJUSTING**

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

**END OF SECTION 22 05 48**

## **22 08 00 – PLUMBING SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS**

### **PART 1 – GENERAL**

#### **1.1. RELATED DOCUMENTS**

- 1.1.1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.1.2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

#### **1.2. SUMMARY**

- 1.2.1. The purpose of this Section is to define responsibilities in the Commissioning Process. Additional system testing is required within individual Specification Sections.
- 1.2.2. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 20-25 Contractors shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Owner's CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- 1.2.3. Plumbing systems to be commissioned include the following:
  - 1.2.3.1. Domestic Water Heaters
  - 1.2.3.2. Domestic Water Circulation Pumps

#### **1.3. DEFINITIONS**

- 1.3.1. Refer to the General Commissioning Requirements for definitions.

#### **1.4. SUBMITTALS**

- 1.4.1. Contractor shall provide Owner and/or CxA with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.
  - 1.4.1.1. Shop drawings and product submittal data related to systems or equipment to be commissioned.
- 1.4.2. Contractor shall submit to Owner and/or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- 1.4.3. Where installation testing may be performed in a progressive manner (i.e., piping hydrostatic testing), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be performed, documented and presented for approval prior to the start of any testing activities.
- 1.4.4. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process

- 1.4.4.1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
- 1.4.4.2. Installation testing reports such as piping hydrostatic testing, piping chemical treatment and flushing, bolt flange torqueing, and any documentation associated with local code authority inspections or authorizations.
- 1.4.4.3. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
- 1.4.4.4. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements.

## **PART 2 - PRODUCTS**

### **2.1. GENERAL**

- 2.1.1. All materials and installation shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- 2.1.2. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- 2.1.3. Contractor is required to follow all applicable industry and site specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

### **2.2. TEST EQUIPMENT**

- 2.2.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- 2.2.2. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

## **PART 3- EXECUTION**

### **3.1. CONSTRUCTION PHASE**

- 3.1.1. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- 3.1.2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.

- 3.1.3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- 3.1.4. Provide additional requested documentation to the Owner and/or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
  - 3.1.4.1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
  - 3.1.4.2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and/or CxA.
  - 3.1.4.3. This information and data request may be made prior to normal submittals.
- 3.1.5. During the installation, Start-up and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- 3.1.6. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
- 3.1.7. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.
- 3.1.8. Incorporate manufacturer's Start-up procedures with System Verification Checklists (SVC).
- 3.1.9. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
- 3.1.10. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
- 3.1.11. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).

3.1.12. Provide training of the Owner's operating personnel as specified.

3.1.13. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

### **3.2. WARRANTY PHASE**

3.2.1. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.

3.2.1.1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.

3.2.2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.

### **3.3. INSTALLATION**

3.3.1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

3.3.2. All installation shall be in accordance with the Project Documents.

### **3.4. TRAINING**

3.4.1. Refer to the individual section of this Specification for specific training requirements on each system.

3.4.2. Refer to the General Commissioning Requirements and Division 01 for overall training requirements related to the Commissioning process and this project.

## **SECTION 22 11 16 - DOMESTIC WATER PIPING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.3 SUMMARY**

- A. Provide a complete domestic water piping system.
- B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories.
  - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
  - 3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
  - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- C. Do not lay pipe on ground, Contractor shall use wood blocking to prevent contact with ground.

#### **1.6 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install underground piping when bedding is wet or frozen.

## 1.7 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

## PART 2 - PRODUCTS

### 2.1 PIPE MATERIALS

- A. Solder shall be composed of 95.5% tin, 4% copper, 0.5% silver. Lead free, antimony free and zinc free. Silvabrite 100 by Engelhard Corporation or approved equal.
- B. One (1) year warranty from substantial completion date.

### 2.2 WATER PIPING, BELOW GRADE

- A. Applies to domestic water pipe buried within 5 feet of building, below grade for water entries.
  - 1. Incoming Water Entry:
    - a. Provide Watts (Ames) IBR 2" and larger 304 stainless steel one piece in building riser (UL, FM Listed) for use in domestic and fire entries.
  - 2. Copper Tubing: ASTM B88, Type K (heavy wall), annealed tempered (soft).
    - a. Pipe Sizes 1-1/2" and Smaller:
      - 1) Seamless copper water tube.
      - 2) Joints: None below slab.
        - a) NOTE: No joints shall be permitted in pressure water pipe below slab on grade. All such piping must be brought up above finished floor line a minimum of 12" before joining. Exception may be taken when pipe is fully enclosed in pressure rated sleeve and pre-approved by the Consultant and Owner. Contractor shall use plastic sleeve where copper tubing is in contact with concrete.
    - b. Pipe Sizes 2" thru 3":
      - 1) Seamless copper water tube, 20 ft. straight lengths.
      - 2) Joints: One joint permitted below slab entry using wrought copper, solder-joint pressure fittings: ASME B16.22 with an approved brazing filler metal or pipe which can be shop bent for no joint installation by using a "bending" temper tubing.
    - c. Pipe Sizes 4" and larger:
      - 1) Ductile iron pipe, ANSI A21.6 or Watts (Ames) IBR 4" thru 10" 304 stainless steel one piece in building riser, UL/FM Listed.
      - 2) Joints: Mechanical
- B. Outside building beyond 5'-0" mark use Schedule 80 fittings when using 3 inch and smaller socket type fittings.

### 2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
  - 1. Fittings: ASME B16.18, cast bronze, or ASTM B16.22 wrought copper alloy,
  - 2. Joints: ASTM B32, solder.
  - 3. At the contractor's option, Press connection copper fittings manufactured by an approved manufacturer or approved equal will be acceptable. Building services



pipng –20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA, UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. The fittings shall include the Smart Connect feature to identify unpressed connections during system testing. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.

- a. Approved manufacturer(s):
  - 1) Viega

## 2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
  1. Ferrous pipe: Class 150 malleable iron threaded unions.
  2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Pipe Size 2-1/2 inches and Larger:
  1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
  2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Dielectric Connections:
  1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
  2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick performed neoprene gasket. (Same as paragraph B, above.)
- D. Contractor option: VIEGA ProPress shall be an acceptable option
- E. No Victaulic split ring flanges to butterfly valves as per CFISD design requirements.

## 2.5 VALVES

- A. General
  1. Water isolation valve shall be installed at every supply pipe to each restroom.
  2. Valves shall be located in accessible ceilings to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
    - a. Valves installed above hard ceiling shall not be permitted per CFISD maintenance—deviation from this requires prior CFISD approval and the use of a 24"x24" access panel directly below the valve.
      - 1) Coordinate size and location of access panel with Architect.
  3. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas above lay-in (accessible) ceilings or with access panels with prior approval from CFISD. No access panels will be permitted in public spaces with gypsum ceilings.
  4. **All valves shall be non-slamming type.**
- B. Ball Valves:
  1. Manufacturers:
    - a. NIBCO INC
    - b. Milwaukee
    - c. Crane, Model # 9303-B

- d. Stockham, Model # S-216BR-1R-T
  - e. Grinnell, Model # 3700-6
  2. Pipe Sizes 2" and Smaller: NIBCO No. T-585-70-66, two-piece bronze ball valve, 600 PSI rated, full port, 316 stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle and balancing stops, 316 stainless steel ball, threaded ends with union.
  3. Pipe Sizes 2-1/2" and Greater: Utilize butterfly valve.
  4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
  5. Ball valves installed outdoors or in-ground shall have stainless steel handle.
  6. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
  7. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.
- C. Globe Valves & Butterfly Valves
1. Manufacturers:
    - a. Nibco
    - b. Stockham
    - c. Crane
    - d. Milwaukee
  2. All globe valves to have hand wheels.
  3. Victaulic flanges shall not be used on butterfly valves.
  4. All butterfly valves shall have stainless steel disc.
- D. Swing Check Valves:
1. Manufacturers:
    - a. NIBCO INC.
    - b. Milwaukee.
    - c. Apollo.
    - d. Kitz.
  2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and threaded ends. No Lead.
  3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.
- E. Balancing Valves (Hot Water Recirculation)
1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi minimum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
  2. Balancing valves shall be Flow Design Incorporated (FDI) model UA Zero or approved equal by ITT or Bell and Gossett.
  3. Ball valves are not acceptable for balancing the hot water return system.

## 2.6 RELIEF VALVES

- A. Manufacturers: Watts Industries, or approved equal.
- B. Temperature and Pressure Relief:
  - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
  - 1. Watts N36 Lead Free Series.

## 2.7 STRAINERS

- A. Manufacturer: NIBCO INC., Apollo.
- B. Two (2) inches and Smaller: Threaded bronze body rated for 175 PSI min, Y pattern with 1/32 inch stainless steel perforated screen. NIBCO INC., 221 Series.
- C. 2-1/2 inches thru 4 inches: Flange rated for 175 PSI min, flanged iron body, Y pattern with 3/64-inch stainless steel perforated screen. NIBCO INC., F-271 Series.
- D. 6 inches and Larger: Flanged rated for 175 PSI min, basket pattern with 1/8 inch stainless steel perforated screen.
- E. Lead Free.
- F. All domestic water systems, PRV's, and backflow preventers shall have strainers as per CFISD design requirements.
- G. Provide fine mesh disposable screen for flushing and cleaning purposes, then install above final screens prior to startup.

## 2.8 GAGES AND TAPS

- A. Manufacturers: For portable water system (Lead Free)
  - 1. Weiss
  - 2. Marsh Bellofram
  - 3. Weksler
  - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
  - 1. Case: Stainless steel.
  - 2. Bourdon Tube: Phosphor bronze.
  - 3. Dial Size: 4-1/2 diameter.
  - 4. Mid-Scale Accuracy: One (1) percent.
  - 5. Scale: Psi.
- C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- D. Ball Valve: Brass 1/4 inch NPT for 250 psi.
- E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.

- F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify excavations are to required grade, dry, and not over-excavated.

#### **3.2 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

#### **3.3 INSTALLATION - BURIED PIPING SYSTEMS**

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Separate trenches for water lines, sanitary and gas piping.
- E. Remove scale and dirt on inside of piping before assembly.
- F. Install pipe on prepared bedding.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Do not use lead bearing solder materials.
- J. Pipe Cover and Backfilling:
  - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
  - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
  - 3. Do not use wheeled or tracked vehicles for tamping.
- K. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

#### **3.4 INSTALLATION - ABOVE GROUND PIPING**

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. For hot water circulation loops into lavatory chase for *multiple* lavatories, provide valved by-pass in accessible ceiling at corridor.
  - 1. Provide additional valves on the loop for hot water entering the restroom and leaving the restroom.

- C. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Insulate all domestic hot water supply and return lines.
- E. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- F. All supply lines shall be flared at end device attachment points.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- I. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- K. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- L. Water isolation valve shall be installed at every supply pipe to each restroom.
- M. Valves shall be located in accessible ceilings to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
  - 1. Valves installed above hard ceiling shall not be permitted per CFISD maintenance—deviation from this requires prior CFISD approval and the use of a 24"x24" access panel directly below the valve.
    - a. Coordinate size and location of access panel with Architect.
- N. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Install water piping in accordance with ASME B31.9.
- Q. Sleeve pipes passing through partitions, walls and floors.
- R. Install unions downstream of valves and at equipment or apparatus connections.
- S. Install valves with stems upright or horizontal, not inverted.
- T. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- U. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- V. Provide check valves on discharge of all water circulating pumps.

- W. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- X. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- Y. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- Z. Route all domestic water piping inside building in climate controlled space not subject to freezing.
- AA. Do not use lead bearing solder materials.
- BB. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
- CC. Lead Free.

### **3.5 INSTALLATION - BACKFLOW PREVENTERS**

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.
- B. Provide a floor drain within six (6) feet of each backflow preventer.
- C. Backflow preventer shall be certified by Contractor.
- D. BFP shall be installed at 3' to 4' above finished floor.
- E. Lead Free.

### **3.6 INSTALLATION – PRESSURE GAGES**

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install gage in piping to each inlet and outlet of water heater.
- E. Install gage in piping to each end of backflow preventer.
- F. Install gage in piping to each end of double check valves.
- G. Install gage in piping to each inlet and outlet of water softener.
- H. Install gage in piping to each inlet of water filter.
- I. Install gage in piping to each inlet of commercial dishwasher machine.

### **3.7 DOMESTIC HOT WATER SYSTEM BALANCING**

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
  - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
  - 2. Verify recirculation pump operation and rotation.
  - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
  - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
  - 2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.
- D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in "Permits" under Part 1 of Section 22 00 00.

### **3.8 FIELD QUALITY CONTROL**

- A. Prior to cover up, pressure test all domestic water piping.
  - 1. Tests shall be witnessed by consultant and Owner.
  - 2. Contractor shall notify Owner 48 hours prior to test. Test shall be witnessed by CFISD Plumbing Technician.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.

**END OF SECTION 22 11 16**

## **SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.3 SUMMARY**

- A. Provide a complete sanitary drainage system.

#### **1.4 SUBMITTALS**

- A. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories.
  - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

#### **1.6 QUALITY ASSURANCE**

- A. Perform Work in accordance with the plumbing code.
- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.



## 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

## PART 2 - PRODUCTS

### 2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

### 2.2 SANITARY SEWER PIPING, BELOW GRADE

- A. PVC Pipe
  - 1. Provide a complete system of solid wall schedule 40 PVC DWV, ASTM D 1785/D 2665 piping with solvent welded joints.
  - 2. Fittings: PVC, ASTM D 3311/D 2665 drainage pattern, with bell and spigot ends to be furnished by the same manufacturer as pipe or approved equal.
    - a. Fittings not permitted:
      - 1) 60-degree fittings
      - 2) Cross nor double combo fittings
  - 3. Joints:
    - a. Pipe Sizes 4" and Smaller:
      - 1) Solvent welded joints with ASTM D 2564 solvent cement, clear, medium-bodied.
    - b. Pipe Sizes 6" and Greater:
      - 1) Solvent welded joints with ASTM D 2564 solvent cement, gray, heavy-bodied.
    - c. Mating surfaces shall be prepared with ASTM F 656 purple primer immediately prior to cement application.
  - 4. Provide tracer wire at all underslab piping at exit point from building slab. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
  - 5. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.
- B. Foam core PVC piping is not acceptable for any drainage system.

### 2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
  - 1. AB&I
  - 2. Charlotte Pipe and Foundry Co.
  - 3. Tyler Pipe/Soil Division

- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
  - 1. Fittings: Cast iron, ASTM A 888 drainage pattern.
    - a. Fittings not permitted:
      - 1) 60-degree fittings
      - 2) Cross nor double combo fittings
  - 2. Joints: No hub, ASTM C 564 neoprene gaskets with ASTM C1540 wide-bodied stainless steel clamp-and-shield assemblies constructed of type 300 series stainless steel.
    - a. Pipe Sizes 4" and Smaller: Four (4) band heavy duty couplings. Coupling assemblies shall conform to FM 1680 where required by AHJ.
    - b. Pipe Sizes 6" and Greater: Six (6) band heavy duty couplings. Coupling assemblies shall conform to FM 1680 where required by AHJ.
    - c. Four (4) band minimum heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
    - d. Acceptable Manufacturers: Husky SD-4000.
  - 3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 Super Duty Transition Cast Iron to Plastic coupling.

#### **2.4 VENT PIPING, ABOVE GRADE**

- A. Use same as Sanitary Sewer Piping, Above Grade.
- B. Vent piping couplings to be minimum of four (4) bands.

#### **2.5 VENT PIPING, BELOW GRADE**

- A. Use same as Sanitary Sewer Piping, Below Grade.

### **PART 3 - EXECUTION**

#### **3.1 FLOOR DRAINS**

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.
- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

#### **3.2 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

- C. Remove scale and dirt, on inside and outside, before assembly.

### 3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert as indicated on Drawings.
- B. Establish minimum separation from other services piping in accordance with code.
- C. Remove scale and dirt on inside of piping before assembly.
- D. Pipe shall be installed in uniform alignment with a minimum uniform slope of:
  - 1. 1/4" per foot for pipe sizes 2-1/2" or less
  - 2. 1/8" per foot for pipe sizes 3" or greater
- E. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- F. Route pipe in straight line.
- G. Excavation:
  - 1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
  - 2. Cut the bottom of the trench or excavation to uniform grade.
  - 3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.
- H. Pipe Cover and Backfilling:
  - 1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
  - 2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
  - 3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at [www.uni-bell.org](http://www.uni-bell.org).
  - 4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- I. Disposal of excess material:
  - 1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.

### 3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.
- B. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
  - 1. All cleanouts shall be in accessible locations.
- C. Install a floor clean out according to the following;
  - 1. Not more than 75' apart in all horizontal drain lines.
  - 2. At each change of direction greater than 45 Deg.
  - 3. At the base of each waste or soil stack.
  - 4. Install floor cleanouts at elevation to accommodate finished floor.
  - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
  - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.
  - 7. Use full size cleanout top exposed in carpeted area (no carpet markers).
- D. Install a wall cleanout according to the following:
  - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
  - 2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets where pipes penetrate the slab including water closets, lavatories and EDF's.
- E. Install an exterior cleanout according to the following:
  - 1. Encase exterior cleanouts in concrete flush with grade.
  - 2. Provide double cleanouts outside of building for sanitary piping in sidewalks. Install minimum of 1'-0" from building. Contractor shall coordinate with Civil to provide manhole connections to main per CFISD Maintenance.
- F. Install a cleanout on top of all sanitary cross fittings and figure "5" fittings inside chase walls.
- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- I. Install piping to maintain headroom. Do not spread piping, conserve space.
- J. Group piping whenever practical at common elevations.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

- M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- N. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Sleeve pipes passing through partitions, walls and floors.
- S. Support cast iron drainage piping at every joint.
- T. Water test all piping per code.
- U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- V. Slope all vent piping to allow for drainage.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.
- Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

### **3.5 RODDING SEWERS**

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

### **3.6 FIELD QUALITY CONTROL**

- A. Separate trenches for water lines, sanitary, storm, and gas piping.
- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.

- D. Foreign pipe and fittings unacceptable.
- E. Prior to cover up sanitary and vent pipe shall be pressure tested.
  - 1. Tests shall be witnessed by consultant and Owner.
  - 2. Contractor shall notify Owner 48 hours prior to test. Test shall be witnessed by CFISD Plumbing Technician.
- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.
  - 1. Civil shall have test/clean from manhole to main per CFISD Maintenance.
- G. For additions and renovations, use camera to locate routing of underslab lines.
- H. Upon completion of the underground and above ground sanitary/vent piping system, the contractor shall notify Engineer and Owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.
  - 1. Contractor shall provide floor plan drawings for above floor piping to be smoke tested.
  - 2. Contractor shall use Hurco brand smoke machine on top of manhole.

**END OF SECTION 22 13 16**

## **SECTION 22 13 21 - ACID WASTE AND VENT SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.2 PLUMBING SYSTEMS DESIGN CRITERIA AND SCOPE OF WORK**

- A. SYSTEMS
  - 1. Systems to be provided under the Plumbing design section shall be as listed below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
    - a. Acid waste and vent piping systems.
    - b. Acid neutralization tanks.
- B. DESIGN STANDARDS
  - 1. Plumbing systems shall be designed and installed in accordance with the requirements of the following codes, standards and design guides:
    - a. The International Plumbing Code, 2012 Edition, with most current State of Texas Amendments
    - b. The International Building Code, 2012 Edition, with most current State of Texas Amendments
    - c. Americans with Disabilities Act (ADA)
    - d. American Society of Plumbing Engineers (ASPE) Data Books
    - e. National Fire Protection Association (NFPA) Standards
      - 1) NFPA 30 - Flammable and Combustible Liquids Code
      - 2) NFPA 58 - Liquefied Petroleum Gases
    - f. Plumbing Drainage Institute (PDI)
    - g. Underwriters Laboratories Inc. (UL)
    - h. National Sanitation Foundation (NSF)
    - i. Local and State Fire Marshal requirements
    - j. Local Building and Inspection Department requirements
    - k. Local Health Department requirements

### 1.3 GENERAL REQUIREMENTS

- A. Division 1, General Requirements and Supplementary Conditions, are hereby made a part of this section as fully as if repeated herein.
- B. The scope of work required by this section of the specifications consists of furnishing all materials, labor, supervision, equipment, appurtenances, accessories, connections, permits and services to perform all plumbing work, complete and placed into approved operating condition, including all tests and adjustments, in strict accordance with these specifications and the Contract Drawings.
- C. The principal work under this section shall include, but not be limited to the following systems and equipment:
  - 1. The Contractor shall furnish and install acid waste and vent piping and dilution basins as indicated on the drawings and/or included in this division of these specifications.
  - 2. Underground acid waste and vent piping including mains, branches, traps, connections to fixture and drains, and connections to stacks, piping to dilution tank; dilution tank(s) and piping connections from tank to designated outfall structure.
- D. The drawings and these specifications are complimentary each to the other, and any labor, or material called for by either, whether or not by both, shall be furnished and installed. The Contractor shall notify the Architect/Engineer of any discrepancies between the drawings and specifications regarding labor or materials prior to submitting bid.
- E. The drawings are diagrammatic in nature and indicate the various systems and piping required. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The plumbing subcontractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions. Particular attention shall be taken to avoid foundations, footing and other structural elements furnished under other sections of the specifications. Any adaptations, modifications, or additions are the responsibility of and shall be borne by this subcontractor and shall be approved by the Engineer before execution. All openings, blockouts or sleeves required for the execution of this subcontract are the responsibility of this subcontractor to coordinate.

### 1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation and backfill for installation of the specified systems shall be done by this subcontractor.
- B. Core drilling, masonry work and painting incidental to the installation of the specified systems shall be included in the scope of work of this subcontractor.



## 1.5 REFERENCES

- A. Codes, Ordinances and Permits
1. All work performed under this section of the Specifications shall conform to all codes, ordinances, and regulations of the City, County, State and/or other authorities having jurisdiction. All work shall conform to the 2000 Standard Plumbing Code with all local amendments as a minimum.
  2. This subcontractor shall give proper authorities all requisite notices, file all required plans relative to the work specified herein with proper authorities, and secure and pay for all permits, licenses and certificates relating to his work.
  3. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

## 1.6 SUBMITTALS

- A. Shop Drawings and Catalog Data
1. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials, and within 30 days from date of contract award. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
    - a. Acid waste and vent piping.
    - b. Acid neutralization tank
  2. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.
  3. Review of shop drawings by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc. Such coordination shall be clearly indicated on the shop drawings.
  4. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

## 1.7 EQUIPMENT, MATERIAL BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

- B. Unless “approved equal” is specifically stated, bids shall be based on equipment named in specifications or on drawings as “base” products.
- C. Alternate “approved equal” items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

#### **1.8 EXAMINATION OF PREMISES**

- A. Prior to the ordering or purchasing of any plumbing equipment or materials or the layout or installation of any work, the Contractor shall examine the premises and verify any and all of the existing conditions under which he will be required to operate, or that will in any manner affect the work under this Contract.

#### **1.9 EXISTING SERVICES**

- A. If existing active services are encountered that require relocation, notify the Architect and relocate as directed. Do not prevent or disturb operation of active services that are to remain.

#### **1.10 COORDINATION OF TRADES**

- A. The plumbing subcontractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. This subcontractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. This subcontractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, this subcontractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. This subcontractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

- F. Plumbing work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

#### **1.11 OBTAINING AND GIVING INFORMATION**

- A. Obtain detailed information from all manufacturers as to the proper method of installing and connecting same. Obtain all required information necessary to facilitate and complete the plumbing installation.
- B. Coordinate the shape, size and position of all openings required for materials and equipment under this section and give full information to other trades sufficiently in advance to allow proper access requirements. Provide all sleeves and supports necessary to complete the work specified under this section.
- C. In case of failure on the part of this subcontractor to give proper information as noted above, all necessary cutting and patching will be performed at this subcontractor's expense.
- D. The information to be furnished by this subcontractor shall include sleeve openings (sizes and locations) and all other pertinent information relative to the plumbing installation. This subcontractor shall also furnish to other trades the dimensions and weights of all major pieces of mechanical equipment, and schedule with other trades the clearances that will be required throughout the building to allow for the passage of same through the building to their required installation locations.

#### **1.12 OPERATING INSTRUCTIONS**

- A. This subcontractor shall give detailed instructions for a period of not less than one-half days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.
- B. Prior to final acceptance by the Owner, this subcontractor shall submit a complete as-built submittal to the Engineer for review, three (3) sets of operating and instructional manuals, spare parts lists, drawings, wiring diagrams, trouble shooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.
- C. A complete set of reproducible as-built drawings shall be provided indicating the location of all concealed piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.
- D. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

#### **1.13 GUARANTEE**

- A. Guarantee for all work furnished and/or installed under this section shall be as specified in Division 1 or a minimum of one (1) year from final acceptance.

## **PART 2 - PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

### **2.2 PIPING SYSTEMS**

- A. General
  - 1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on drawings.
- B. Underground Pipe and Fittings
  - 1. Manufacturers:
    - a. Zurn
    - b. R & G Sloan "GSR"
    - c. Orion
  - 2. Pipe sizes 1-1/2" to 6": Polypropylene (PF12), Schedule 40, DWV type with ASTM requirements F1412. Schedule 40 polypropylene fusion welded fittings conforming to ASTM D3311 DWV.
    - a. Joints shall be mechanical type with heavy bituminous coating on exposed metal parts.
    - b. Joints shall be electric heat fusion type.
  - 3. Provide tracer wire at all underslab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
- C. Aboveground Pipe and Fittings
  - 1. Manufacturers:
    - a. Zurn
    - b. R & G Sloan "GSR"
    - c. Orion
  - 2. Pipe sizes 1-1/2" to 4": Polyvinylidene Fluoride (PVDF), flame retardant, schedule 40, DWV type, with recessed drainage fittings, ASTM "D" 4101 and ASTM-2657.
    - a. Rated for return air plenums per ASTM E84 25/50 and UL723.
    - b. Joints shall be mechanical type.
    - c. Joints shall be electric heat fusion type.
- D. Floor Drains
  - 1. Corrosion resistant drain with sediment bucket and fiber-filled grate, Polyvinylidene Fluoride (PVDF), ASTM D4101, socket fusion or mechanical joint connection, Orion model AWF DSTD or approved equal.

- E. Floor Cleanout
  - 1. Corrosion resistant floor cleanout with countersunk plug, ASTM-D-4101, round nickel bronze cover, AWCO (acid waste cleanout) cast in cover, Orion model FCO-SQ or approved equal.
  
- F. Acid Waste Drainage Piping Materials and Products
  - 1. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in chemical drainage piping systems.
  - 2. Where more than one type of material or product is indicated, selection is Installer's option, however, systems of piping must remain consistent in the type of materials and fittings utilized.
  - 3. The Acid Dilution Basin shall be as indicated on the plumbing drawings.

### **PART 3 - EXECUTION**

#### **3.1 PIPING SYSTEMS**

- A. Waste, Vent and Indirect Waste Piping - General
  - 1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/4 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines 4 inches and over in size, but in no event should any pipeline have a slope less than 1/8 inch per foot.
  - 2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the drawings.
  - 3. The main ventilation stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least 3 feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward a waste line.
  - 4. Piping is to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.
  - 5. Fire wrap non rating piping in return air plenum as required. Re section 22 05 29 for additional requirements.

#### **3.2 TESTING OF PIPING SYSTEMS**

- A. General

1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with 48 hours minimum notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by this subcontractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

**B. Acid Waste Piping Systems**

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet head of water. In testing successive sections at least the upper 10 feet of the next preceding section shall be tested so that no joint of piping in the building except the uppermost 10 feet of the system shall be submitted to a test of less than a 10 foot of head water. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
3. Exterior connections shall be tested as part of the interior systems.

**C. Defective Work**

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

**D. Additional Tests**

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

**3.3 EXCAVATION AND BACKFILL**

- A. The Contractor shall do all necessary excavations for all piping, equipment and apparatus under this section and shall backfill trenches by filling and tamping in not more than 6" layers after pipes have been installed, tested and approved. Care shall be taken not to excavate below depth necessary. If excessive excavation is made or pipes are installed in filled areas, fill soil shall be tamped to compaction as specified under the Division 2 specifications. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.
- B. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

### **3.4 FIXTURE CONNECTIONS AND SUPPORTS**

- A. Wall fixtures shall be hung by means of wall hangers supported by at least four (4) 3/8" lag bolts and expansion shields.

### **3.5 SLEEVES**

- A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

### **3.6 INSTALLATION OF UNIONS**

- A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

### **3.7 TRAPS**

- A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

### **3.8 CLEANOUT INSTALLATION**

- A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- B. Install a floor clean out according to the following;
  - 1. Not more than 40' apart in all horizontal drain lines.
  - 2. At each change of direction greater than 45 Deg.

3. At the base of each waste or soil stack.
  4. Install floor cleanouts at elevation to accommodate finished floor.
  5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
  6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.
- C. Install a wall cleanout according to the following:
1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
- D. Install a exterior cleanout according to the following:
1. Encase exterior cleanouts in concrete flush with grade.
  2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.

### **3.9 FLASHING INSTALLATION**

- A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.
- B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

### **3.10 EQUIPMENT AND MATERIAL PROTECTION**

- A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

### **3.11 SPACE REQUIREMENTS**

- A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

**END OF SECTION 22 13 21**



## **SECTION 22 14 13 - STORM DRAINAGE PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.2 SUMMARY**

- A. Provide a complete storm drainage piping system.
- B. Section Includes:
  - 1. Storm Piping Below Grade
  - 2. Storm Piping Above Grade

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories.
  - 2. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### **1.5 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install underground piping when bedding is wet or frozen.

### **PART 2 - PRODUCTS**

#### **2.1 PIPING MATERIALS**

- A. Products and materials listed herein are for references of approved materials.

- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- C. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

## **2.2 STORM WATER PIPING, BELOW GRADE**

- A. PVC Pipe
  - 1. Provide a complete system of solid wall schedule 40 PVC DWV, ASTM D 2665/D 1785 piping with solvent welded joints.
  - 2. Fittings: PVC, ASTM D 3311/D 1785 drainage pattern, with bell and spigot ends to be furnished by the same manufacturer as pipe or approved equal.
    - a. Fittings not permitted:
      - 1) 60-degree fittings
      - 2) Cross nor double combo fittings
  - 3. Joints: ASTM D 2855, solvent weld with ASTM D 2564 solvent cement.
    - a. Pipe Sizes 4" and Smaller:
      - 1) Solvent welded joints with ASTM D 2564 solvent cement, clear, medium-bodied.
    - b. Pipe Sizes 6" and Greater:
      - 1) Solvent welded joints with ASTM D 2564 solvent cement, gray, heavy-bodied.
    - c. Mating surfaces shall be prepared with ASTM F 656 purple primer immediately prior to cement application.
  - 4. Provide tracer wire at all underslab piping at exit point from building slab. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
- B. Foam core PVC piping is not acceptable for any drainage system.

## **2.3 STORM WATER PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: ASTM A74 and CISPI 301, hub and spigot, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
  - 1. Fittings: Cast iron, ASTM A74 drainage pattern.
    - a. Fittings not permitted:
      - 1) 60 degree fittings
      - 2) Cross nor double combo fittings
  - 2. Joints: Hub and spigot, ASTM C 564 neoprene, compression-type gaskets.
    - a. No-hub couplings shall also acceptable, provide Husky SD 4000 at no-hub couplings for CI-to-CI connections and provide Husky SD 4200 at no-hub transition couplings for PVC-to-CI.
      - 1) Pipe Sizes 4" and Smaller: Four (4) band heavy duty couplings. Coupling assemblies shall conform to FM 1680 where required by AHJ.
      - 2) Pipe Sizes 6" and Greater: Six (6) band heavy duty couplings. Coupling assemblies shall conform to FM 1680 where required by AHJ.

- 3) Four (4) band minimum heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

#### **3.2 INSTALLATION - BURIED PIPING SYSTEMS**

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe with uniform slope of not less than 1/8 of an inch per foot.
- F. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- G. Route pipe in straight line.
- H. Pipe Cover and Backfilling:
  1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of pipe.
  2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
  3. Do not use wheeled or tracked vehicles for tamping.

#### **3.3 INSTALLATION - ABOVE GROUND PIPING**

- A. Establish invert elevations, slopes for drainage 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.
- B. All cleanouts shall be in accessible locations.
- C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearance at cleanout for snaking drainage system.
- D. Encase exterior cleanouts in concrete flush with grade.

- E. Install floor cleanouts at elevation to accommodate finished floor.
- F. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- G. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- H. Install piping to maintain headroom. Group piping to conserve space.
- I. Group piping whenever practical at common elevations.
- J. Support cast iron drainage piping at every joint.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- O. Install bell and spigot pipe with bell end upstream.
- P. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- Q. Provide heavy-duty clamps, fittings and gaskets at no-hub connections to all roof and overflow drains then transition to bell and spigot piping system.
- R. Insulate all horizontal and vertical storm drain piping with fiberglass insulation with service jacket. For exposed locations provide rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow all the way to change to vertical direction, including vertical piping and y-fittings.

### **3.4 RODDING SEWERS**

- A. All storm lines, both in the building and out, shall be rodded out after completion of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

**END OF SECTION 22 14 13**

## **SECTION 22 15 13 - COMPRESSED-AIR PIPING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.3 SUMMARY**

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 125 psig and less. Make connections to compressor, dryer, filter, and other related items of equipment and piping accessories, and extend air piping through building to all equipment, fixtures and outlets requiring same.

#### **1.4 SUBMITTALS**

- A. Product Data for the following:
  - 1. Pipes, tubes, and fittings.
  - 2. Flexible pipe connectors.
  - 3. Safety valves.
  - 4. Pressure regulators.
  - 5. Filters
  - 6. Automatic drain valves.
  - 7. Quick couplings.
  - 8. Hose assemblies.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.5 QUALITY ASSURANCE**

- A. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.

- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

## **PART 2 – PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

### **2.2 SYSTEM DESCRIPTION**

- A. Shop air operating at 125 psig (1200 kPa).

### **2.3 PIPES, TUBES AND FITTINGS**

- A. Schedule 40, Galvanized steel Pipe: ASTM A 53.
  - 1. Steel Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
  - 2. Malleable-Iron Fittings: ASME B16.3, Class 150, threaded. Provide Class 300 and galvanized finish if indicated.
  - 3. Malleable-Iron Unions: ASME B16.39, Class 150, threaded.
  - 4. Joints: Screwed for sizes less than 4", flanged or mechanical cut grooved couplings for sizes 4" and larger.
- B. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.
  - 1. Manufacturers:
    - a. ANAMET Inc.
    - b. Flex-Hose Co., Inc.
    - c. Flexicraft Industries.
    - d. Hyspan Precision Products, Inc.
    - e. Mercer Rubber Co.
    - f. Metraflex, Inc.
    - g. Proco Products, Inc.
    - h. Unaflex, Inc.
  - 2. Stainless-Steel-Hose/Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
    - a. Working-Pressure Rating: 200 minimum.
    - b. End Connections NPS 2 and Smaller: threaded Steel pipe nipple.
    - c. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

### **2.4 UNIONS AND COUPLINGS**

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.5 VALVES

- A. Ball Valves:
  - 1. 1/4 inch to one (1) inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70.
  - 2. 1-1/4 inch to 3 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port. Nibco T-580-70.

## 2.6 SPECIALTIES

- A. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
  - 1. Manufacturers:
    - a. Aeroquip Corporation.
    - b. Bowes Manufacturing, Inc.
    - c. Foster Manufacturing Co., Inc.
    - d. Milton Industries, Inc.
    - e. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.
    - f. Rectus Corp.
    - g. Schrader-Bridgeport; Amflo Div.
    - h. Schrader-Bridgeport/Standard Thomson.
    - i. Snap-Tite, Inc.
    - j. TOMCO Products Inc.
    - k. Tuthill Corporation; Hansen Coupling Div.
  - 2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
    - a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
    - b. Plug End: Straight-through type with serrated outlet for attaching hose.
- B. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
  - 1. Hose: double-wire-braid, CR-covered hose for compressed-air service.
  - 2. Hose Clamps: Stainless-steel clamps or bands.
  - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.

## PART 3 – EXECUTION

### 3.1 PREPARATION

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the follow conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
  - 1. Notify Owner not less than seven (7) days in advance of proposed interruption of compressed-air service.

### **3.2 PIPING APPLICATIONS**

- A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating use din applications below, unless otherwise indicated.
- B. Joining of Dissimilar Metal Piping: Use dielectric fittings.
  - 1. NPS 2 and Smaller: Dielectric unions.
  - 2. NPS 2-1/2 to NPS 4: Dielectric flanges.
  - 3. NPS 6 and Larger: Dielectric flange kits.
- C. Low-Pressure Compressed-Air Piping: Use the following piping materials for each size range:
  - 1. NPS 4 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron or press-connect fittings; and threaded or press-connected joints.
  - 2. NPS 6 to NPS 12: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

### **3.3 PIPING INSTALLATION**

- A. Install air and drain piping with 1 percent slope downward in direction of airflow.
- B. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- C. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- D. Install flexible pipe connector on each connection to air compressors.
- E. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver.

### **3.4 VALVE INSTALLATION**

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
- C. Install pressure regulators on compressed-air piping where reduced pressure is required.
- D. Install flexible pipe connectors in discharge piping [and in inlet air piping from remote air-inlet filter] of each air compressor.

### **3.5 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.



- C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

### **3.6 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
  - 2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
  - 3. Repair leaks and retest until no leaks exist.
  - 4. Report results in writing.

**END OF SECTION 22 15 13**

## **SECTION 22 20 23 - GAS PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.3 SUMMARY**

- A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.
- B. This section covers the complete first-class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

#### **1.4 REFERENCE STANDARDS**

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. 2015 Edition of the International Fuel Gas Code.
  - 2. Latest Edition of NFPA 54, National Fuel Gas Code.
  - 3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.

#### **1.5 SUBMITTALS**

- A. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories.
  - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
    - a. Strainers.
    - b. Natural gas pressure regulators.
    - c. Natural gas pressure relief valves.
    - d. Tape form pipe coating.
  4. Contractor shall provide submittal copy of gas piping material and domestic manufacturer for approval to Bill Smith & Jesse Clayburn at Cypress-Fairbanks ISD.
- B. Test Reports: Indicate results of piping system pressure test.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

#### **1.7 QUALITY ASSURANCE**

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- E. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- F. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

## **1.9 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install underground piping when bedding is wet or frozen.

## **1.10 EXTRA MATERIALS**

- A. Furnish two packing kits for each type and size valve.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.
- C. Acceptable manufacturers shall be National Tube, Republic, and Youngstown

### **2.2 NATURAL GAS PIPING, BELOW GRADE (OUTDOOR)**

- A. Pipe shall be yellow polyethylene with socket heat fusion joints and fittings. Pipe sizes 1-1/2" and 2" shall be SDR 11, (PE 2406) and pipe sizes 3" and 4" shall be SDR 11.5 (PE 2406). All socket heat fusion fittings shall be D.O.T. approved and meet ASTM D-2513 and ANSI B31.8 codes.

### **2.3 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)**

- A. All gas piping above grade shall be Schedule 40 Black Steel as manufactured by National Tube, Republic, Youngstown or approved equal domestic manufacturer. All gas piping shall be painted yellow.
  - 1. Pipe Sizes 2" and Smaller:
    - a. Gas piping shall be socket weld, ASTM A106 or ASTM A52 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3. All screwed fittings shall be Crane, or approved domestic manufacturer equal, Class 150 malleable iron. Screwed joints shall be made up with graphite and oil or Teflon tape. Screwed threads shall be in accordance with American Pipe Thread Standards.
  - 2. Pipe Sizes 2-1/2" and Greater:
    - a. Gas piping shall be Type "S" seamless or Type "E" electric resistance welded construction, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints. All welded fittings shall be factory-made and shall be full line size for each tee, branch, elbow, etc., with reducers after fittings, if required.
  - 3. All piping and fittings shall be from a domestic manufacturer.
  - 4. All pipe fittings shall be of materials as follows:
    - a. All welding fittings shall be factory-made and shall be full line size, for each tee, branch, elbow, etc., with reducers after fittings, if required.

- b. All pipe welding shall be performed by a certified welder with pipe-welding experience.
  - c. All screwed fittings shall be Crane, or approved equal, Class 150 malleable iron. Screw joints shall be made up with graphite and oil or Teflon tape. Screwed threads shall be in accordance with American Pipe Thread Standards.
  - d. All piping and fittings shall be from a domestic manufacturer.
  - e. Send copy of gas piping material and domestic manufacturer for approval to Bill Smith & Shannon Thompson at Cypress-Fairbanks ISD.
  - f. Provide test valve opening downstream of main gas shut-off and meter but before building entry, with valve to be Nibco T585-70UL (1/4") with plug cap.
- B. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

#### **2.4 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)**

- A. All gas piping above grade shall be Schedule 40 Black Steel as manufactured by National Tube, Republic, Youngstown or approved equal domestic manufacturer. All gas piping shall be painted yellow.
- B. Steel Pipe: ASTM A53 Schedule 40 black.
  - 1. Fittings: ASME B16.3, malleable iron, 2" pipe and smaller shall be socket weld.
  - 2. Joints: NFPA 54, welded to ASME B31.9 for pipe greater than 2" in size.

#### **2.5 UNIONS AND COUPLINGS**

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- C. Unions shall not be permitted above gypsum ceiling areas and in walls nor chases.

#### **2.6 VALVES**

- A. Valves shall not be permitted above gypsum ceiling areas and in walls nor chases.
- B. Manufacturers:
  - 1. NIBCO.
  - 2. Milwaukee.
  - 3. Crane
  - 4. Stockham
- C. Ball Valves:
  - 1. 1/4" pipe size, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.

2. ½" inch to 3 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port. Nibco T-580-70-UL.

D. Plug Valves:

1. DeZurick Series 425 or 435 eccentric valves with RS 49 plug seals, UL Listed.

## 2.7 STRAINERS

- A. Strainers shall not be permitted above gypsum ceiling areas and in walls nor chases.
- B. Manufacturers:
1. O.C. Keckley Company or approved equal.
- C. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- D. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- E. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

## 2.8 NATURAL GAS PRESSURE REGULATORS

- A. Manufacturers:
1. BelGas.
  2. Itron.
  3. Honeywell.
  4. Sensus.
  5. Maxitrol.
  6. Fisher.
- B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.
  2. Body: Steel.
  3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
  4. Disk, diaphragm, and O-ring: Nitrile.
  5. Maximum inlet pressure: 150 psig
  6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

## 2.9 NATURAL GAS PRESSURE RELIEF VALVES

- A. Manufacturers:
1. Fisher 289H, or approved equal.
- B. Product Description: Spring loaded type relief valve.

1. Body: Aluminum.
2. Diaphragm: Nitrile.
3. Orifice: Brass.
4. Maximum operating temperature: 150 degrees Fahrenheit.
5. Inlet Connections: Threaded.
6. Outlet or Vent Connection: Same size as inlet connection.

## **2.10 UNDERGROUND PIPE MARKERS**

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

## **2.11 EMERGENCY SHUT-OFF VALVE**

- A. Kitchen.
  1. The main gas supply to kitchen equipment shall be provided with an automatic solenoid valve with manual reset lever. The valve shall be interconnected with the hood fire suppression system to shut down gas supply to all kitchen equipment.
  2. The valve shall be energized to open, closed when de-energized with manual reset. The required voltage shall be coordinated with the electrical contractor. The valve shall carry a UL Listing.
  3. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
  4. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
  5. Valves 3/4"-2-1/2" in size shall be ASCO 8044 series.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify excavations are to required grade, dry, and not over-excavated.

### **3.2 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipeline.

### **3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS**

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.
- E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.
  - 1. Connecting multiple regulator vents together shall be prohibited.
- F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- G. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- H. Gas piping installed in plenums and chases shall be welded.
- I. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- J. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.
- K. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.
- L. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.
- M. Provide separate gas valves on each fixture in labs.
- N. Provide a gas isolation valve on the lab controller unit.
- O. Install a test port of each side of all natural gas pressure regulators.
- P. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.
- Q. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

### **3.4 FIELD QUALITY CONTROL**

- A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours. Final gas piping test shall be with 24 inch column of mercury gauge.



1. Notify the district 48 hours prior to any gas system test. Test shall be witness by CFISD plumbing technician.
- B. Railroad Commission of Texas Pipeline Safety \* FORM PS-86B shall be filled out and original transmitted to owner.
- C. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

**END OF SECTION 22 20 23**

## **SECTION 22 30 00 - PLUMBING EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.2 SUMMARY**

- A. Provide a complete installation for each equipment type listed in this section.
- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- C. Section Includes:
  - 1. VACUUM RELIEF VALVES
  - 2. T & P RELIEF VALVES
  - 3. ART ROOM SINK PLASTER TRAP
  - 4. OVERHEAD AIR HOSE REEL (HR-1)
  - 5. BACKFLOW PREVENTERS
  - 6. WATER PRESSURE REGULATING VALVES
  - 7. WATER HAMMER ARRESTORS
  - 8. THERMOSTATIC MIXING VALVES
  - 9. SOLENOID VALVES
  - 10. FLOW METER
  - 11. TEMPERATURE INSTRUMENTS

#### **1.3 SUBMITTALS**

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.

- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

## **1.5 EXTRA MATERIALS**

- A. Furnish two pump seals.

## **PART 2 - PRODUCTS**

### **2.1 VACUUM RELIEF VALVES**

- A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.
- B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

### **2.2 T & P RELIEF VALVES**

- A. Manufacturers: Watts Industries or approved equal.
- B. Temperature and Pressure Relief:
  - 1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
  - 1. Watts N36 Lead Free Series.

### **2.3 ART ROOM SINK PLASTER TRAP**

- A. Manufacturer: Jay R. Smith 8714 Series.
- B. Construction: Fabricated Steel Body and Cast-Iron Cover with Galvanized Sub-Coat with White Duco Finish Inside and Outside and Stainless-Steel Perforated Bucket.
- C. Coordinate installation with Architectural casework installer, allow adequate room for bucket removal.
- D. Install only one (1) art room sink plaster trap to serve all art room sinks.
- E. Install union downstream of plaster trap to allow for removal and cleaning by maintenance personnel.

### **2.4 OVERHEAD AIR HOSE REEL (HR-1)**

- A. Overhead air hose reel with 50' 1/2" air hose. Model: Balcrank 2111-036.

### **2.5 BACKFLOW PREVENTERS**

- A. Acceptable manufacturers:
  - 1. Watts
  - 2. Febco

3. Apollo
- B. Reduced Pressure Backflow Preventers:
  1. Comply with ASSE 1013.
  2. Bronze body, with bronze internal parts and stainless-steel springs.
  3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
  4. Only accepted manufacturers:
    - a. (3/4" thru 2" in Size): Watts Series LF909
    - b. (2-1/2" and Larger in Size): Apollo RPLF 4A Stainless Steel Body
    - c. BFP shall be installed 3' to 4' above finished floor
- C. Double Check Valve Assemblies:
  1. Comply with ASSE 1012.
  2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
  3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
  4. Manufacturer:
    - a. Watts Series 9D
- D. Dual Check Valves:
  1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
  2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
  3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
  4. Manufacturer:
    - a. Watts Model SD-2/9BD
- E. Lead Free
- F. Connect drain with fixed air gap assembly to the nearest floor sink with hard copper and fittings.

## 2.6 WATER PRESSURE REGULATING VALVES

- A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
  1. Sizes 1/2" through 2"
  2. All bronze body
  3. 0.25% maximum weighted average lead content
  4. Integral stainless-steel strainer screen
  5. Built-in bypass check valve
  6. FDA approved elastomers
  7. Renewable seat
  8. Union end connection
  9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
  10. Manufactured by Wilkins Series 600XL or approved equal by Watts

- B. Large Demand Systems
  - 1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
  - 2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
  - 3. Pressure reducing pilot control
  - 4. Stainless steel disc guide, seat and bearing cover
  - 5. Stainless steel stem, nut and spring
  - 6. FDA approved Nylon reinforced Buna-N rubber diaphragm
  - 7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
  - 8. Cla-Val Company Series 90 or approved equal by Watts

## 2.7 WATER HAMMER ARRESTORS

- A. Manufacturers: Precision Plumbing Products SC series.
- B. ANSI A112.26.1; copper construction, piston type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.
- D. Access Panel: Acorn Model 8292 or approved equal.
- E. Lead Free.

## 2.8 THERMOSTATIC MIXING VALVES:

- A. Manufacturers:
  - 1. Symmons
  - 2. Leonard.
  - 3. Power.
- B. Certified to ASSE Standard 1017, ASSE 1070, and meets the anti-scald requirements of ASSE Standard 1016.
- C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- D. Capacity:
  - 1. TMV-1: Flow capacity between 0.35 gpm Min. and 4 gpm Max. at 5 psi pressure drop. Lead Free.
    - a. Model:
      - (1) Leonard – 170-LF
      - (2) Power - LFLM495
  - 2. TMV-2: 3 gpm Min. and 14 gpm Max. at 5 psi pressure drop. Lead Free
    - a. Model:
      - (1) Leonard – LV-186-982-LF-STSTL-REC.
      - (2) Power – ETV200
  - 3. TMV-3: 3 gpm Min. and 30 gpm Max. at 5 psi pressure drop. Lead Free
    - a. Model:
      - (1) Leonard – LV-186-983-LF-STSTL-REC.
      - (2) Power – ETV200
- E. Accessories:
  - 1. Check valve on inlets.
  - 2. Volume control shut-off valve on outlet.

3. Stem thermometer on outlet.
  4. Strainer stop checks on inlets.
- F. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.
- G. Mechanical Rooms: Omit cabinet, surface mount.
- H. Mount:
1. TMV-1 in piping under lavatory/sink/etc.
  2. TMV-2 in wall mounted stainless steel cabinet.
  3. TMV-3 in wall mounted stainless steel cabinet
- I. Lead Free.

## 2.9 SOLENOID VALVES

- A. ASCO Series Next Generation
- B. Provide at each kitchen cooking hood and at each science lab prep room and demo table where for automatic gas supply shut-off.
- C. Coordinate electrical connections with Division 26.

## 2.10 FLOW METER

- A. Provide by BAS Contractor and Division 23, Plumbing Contractor shall install as required and coordinate with necessary trades.

## 2.11 TEMPERATURE INSTRUMENTS

- A. Manufacturer: Trerice, Taylor, Marsh, Weksler, Marshalltown, Weiss, or Miljoco.
- B. Thermometer Wells.
1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
  2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
  3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
  4. Wells shall be sized to extend a minimum of 50% into pipe

## 2.12 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00
- B. All water heaters shall use brass ball valves and all drain piping is to be copper and routed to floor sink. CPVC can be used for indirect waste to drains.

- C. For air compressors, provide automatic condensate purge function. Provide piping as necessary to closest floor drain. Coordinate additional power requirements. Provide bypass around automatic drain valve
- D. Do not use high level alarms for grease traps.
- E. Do not use vandal proof screws.
- F. Do not use garbage disposals at sinks.
- G. Install water heater with the followings.
  - 1. Maintain manufacturer's recommended clearances around and over water heaters.
  - 2. Connect natural gas piping in accordance with NFPA 54.
  - 3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.
  - 4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
  - 5. Install the following piping accessories.
    - a. On supply:
      - (1) Thermometer well and thermometer.
      - (2) Strainer.
      - (3) Pressure gage.
      - (4) Shutoff valve.
      - (5) Diaphragm-type expansion tank
    - b. On return:
      - (1) Thermometer well and thermometer.
      - (2) Pressure gage.
      - (3) Shutoff valve.
  - 6. Install the following piping accessories on natural gas piping connections.
    - a. Strainer.
    - b. Pressure gage.
    - c. Shutoff valve.
    - d. Pressure reducing valve.

7. Install discharge piping from relief valves and drain valves to nearest floor drain.
  8. Install circulator and diaphragm expansion tank on water heater.
  9. Install water heater trim and accessories furnished loose for field mounting.
  10. Install electrical devices furnished loose for field mounting.
  11. Install control wiring between water heater control panel and field mounted control devices.
  12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.
  13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.
- H. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
1. Install the following piping accessories.
    - a. On supply:
      - (1) Pressure gage.
      - (2) Shutoff valve.
      - (3) Check valve.
    - b. On return:
      - (1) Thermometer well and thermometer.
      - (2) Timer.
      - (3) Pressure gage.
      - (4) Shutoff valve.
- I. Water softener: Install system components according to manufacturer's published recommendations and pipe as indicated on Drawings. Care shall be exercised in fabricating plumbing lines to avoid all cross connections eliminate the possibility of water contamination.
1. Provide and install double check valve assembly backflow prevention on the potable water line serving the water softener downstream of all potable water connections serving any other outlets or equipment.
  2. Backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (twenty-four hour) water service is required.



3. Provide a physical air gap of at least two times the diameter of the softener equipment drain piping discharging into a floor drain/sink receptor.
4. Provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation and acquaint the operators with the proper operation and maintenance of the equipment.

J. Backflow Preventers and Vacuum Breakers.

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.
2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.
3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.
5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.
6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.
7. Install at 3' – 4' AFF. Backflow preventer must be easily accessible for testing and maintenance.

K. Water Hammer Arrestors (Hydraulic Shock Absorbers).

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.
2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.
3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.

L. Water Pressure Regulating Valves.

1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.
2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.

3. Installation shall allow sufficient access to and space around components for adjustments and servicing.
  4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators
- M. Grease traps shall be cleaned and pumped prior to substantial completion. Interior joints shall be properly sealed.
- N. Install diaphragm-type expansion tank on cold water supply line.
- O. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.
- P. Sewer and Sump pump Discharge Piping:
1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.
  2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

**END OF SECTION 22 30 00**

## **SECTION 22 40 00 - PLUMBING FIXTURES**

### **PART 1 – GENERALS**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### **1.3 SUMMARY**

- A. Provide a complete system of plumbing fixtures and trim.
- B. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- C. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that went into effect January 2014.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

#### **1.6 EXTRA MATERIALS**

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

### **PART 2 - PRODUCTS**

#### **2.1 FLUSH VALVE WATER CLOSETS**

- A. Fixture Manufacturers:
  - 1. American Standard.

2. Kohler Co.
  3. Toto
  4. Sloan
  5. Zurn.
- B. Fixture Trim Manufacturers:
1. Toto
  2. Sloan Valve Co.
  3. Zurn Industries
  4. Moen Commercial
- C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps.
1. Wall Mounted: American Standard 3351.101.020
  2. Or equal from list of acceptable manufacturers.
  3. Trim : (Type C)
- D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
1. Wall Mounted: American Standard 3351.101.020
  2. Or equal from list of acceptable manufacturers.
  3. Trim : (Type C)
  4. Provide flush valve stem offset as required.
- E. Trim:
1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal 111 or equal from list of acceptable manufacturers.
- F. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis 1655CT.
- G. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Jay R. Smith 200 series carriers, or equal by Zurn and Watts.

## 2.2 WALL HUNG URINALS

- A. Fixture Manufacturers:
1. American Standard.
  2. Kohler Co.
  3. Toto
  4. Sloan
  5. Zurn.

- B. Fixture Trim Manufacturers:
  - 1. Toto
  - 2. Sloan Valve Co.
  - 3. Zurn Industries
  - 4. Moen Commercial
- C. All urinal flush valves shall meet the latest mandates and requirements for lead free required by law that went into effect January 2014.
- D. U-1: ASME A112.19.2M; vitreous china, wall hung, elongated rim integral trap, removable stainless steel strainer, 3/4 inch top spud, provide chair carrier as required. American Standard Washbrook Model 6590001.020 compatible with 0.125 gpf flush volume or equal from list of acceptable manufacturers.
  - 1. Trim : (Type C)
- E. U-2: Same as U-1, except mounted at ADA/TAS height for appropriate age group.
  - 1. Trim : (Type C)
- F. Trim:
  - 1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal 186 or equal from list of acceptable manufacturers.
- G. **As per CFISD requirements: All urinals MUST accommodate the following type of strainer:**
  - 1. American Standard Washbrook FloWise Vandal Resistant Strainer, model 7381408-200.0020A
- H. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with rectangular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. Provide bottom bearing plate. Jay R. Smith figure 0637, or equal by Zurn and Watts.

### 2.3 LAVATORIES

- A. Fixture Manufacturers:
  - 1. American Standard.
  - 2. Kohler Co.
  - 3. Toto
  - 4. Sloan
  - 5. Zurn.
- B. Fixture Trim Manufacturers:
  - 1. Chicago
  - 2. American Standard

3. Moen Commercial
4. Zurn
- C. Supply Fittings Manufacturers:
  1. T&S Brass.
  2. McGuire.
- D. All lavatory faucets and trim shall meet the latest mandates and requirements for lead free required by law that went into effect January 2014.
- E. L-1, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0355.012 or equivalent from list of acceptable manufacturers. Vitreous china wall hung lavatory 21 x 15 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type.
  1. At student only restrooms: Trim Type A1
  2. At faculty/adult restrooms: Trim Type E2
- F. L-2, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0356.421 or equivalent from list of acceptable manufacturers. Vitreous china wall hung lavatory 21 x 15 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type.
  1. At student only restrooms: Trim Type A1
  2. At faculty/adult restrooms: Trim Type E2
- G. L-3, Vitreous China Counter Top Basin: ASME A112.19.2M; vitreous china self-rimming counter top lavatory, 20 x 17 inches with drillings on four (4) inch centers, front overflow, soap depression, seal of putty, caulking, or concealed vinyl gasket. (Oval) American Standard 0476.028 or equivalent from list of acceptable manufacturers.
  1. At student only restrooms: Trim Type A1
  2. At faculty/adult restrooms: Trim Type E2
- H. Trims:
  1. At student only restrooms: Supply Fitting: ASME A112.18.1 (Type A1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series or equivalent from list of manufacturers. Chicago 802-VE2805-665ABCP or provide as indicated on plumbing fixture schedule
  2. At faculty/adult restrooms: Supply Fitting: ASME A112.18.1 (Type E2); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent from list of manufacturers. Chicago Faucet 895-317E65VRGD1AB.

## 2.4 SINKS

- A. Fixture Manufacturers:
  1. Elkay Mfg.
  2. Moen

- B. Fixture Trim Manufacturers:
  - 1. Chicago
  - 2. T & S Brass
  - 3. American Standard
  - 4. Moen Commercial
  - 5. Zurn
- C. Supply Fittings Manufacturers:
  - 1. T&S Brass
  - 2. McGuire
- D. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that went into effect January 2014.
- E. SK-1: Single Compartment Bowl: ASME A112.19.3; 19-1/2 x 19-1/2" x 6-1/2 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ191965PD or provide as indicated on plumbing fixture schedule.
  - 1. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-5-317AB, or equivalent by accepted manufacturers.
- F. SK-2: Double Compartment Bowl: ASME A112.19.3; 33 x 19-1/2 x 6-1/2 inch outside dimensions 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. Elkay Model LRADQ331965PD or provide as indicated on plumbing fixture schedule.
  - 1. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-5-317AB, or equivalent by accepted manufacturers.
- G. SK-3: Single Compartment Bowl: ASME A112.19.3; 25" x 21-1/4" x 6-1/2" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ252165PD or provide as indicated on plumbing fixture schedule.
  - 1. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-5-317AB, or equivalent by accepted manufacturers.
- H. SK-4: Single Compartment Bowl: ASME A112.19.3; 31 x 22" x 5 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRAD312250 or provide as indicated on plumbing fixture schedule.

1. Trim: ASME A112.18.1 (Type J2); chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-5-317AB, or equivalent by accepted manufacturers.
- I. SK-5: Single Compartment Bowl: ASME A112.19.3; 16-3/4" x 15-1/2" x 6" outside dimensions, 20 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model CHS1716C or provide as indicated on plumbing fixture schedule.
  1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by accepted manufacturers.
- J. SK-6: Single Compartment Bowl: ASME A112.19.3; 48" x 20" x 8" outside dimensions, 16 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model EWMA4820C or provide as indicated on plumbing fixture schedule.
  1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by accepted manufacturers.
2. Accessories:
  3. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
  4. Chrome plated 17 gage brass basket strainer.
  5. Removable key stops.
  6. Flexible supplies.
  7. Trap and waste insulated and offset to meet ADA compliance.
- K. Provide offset waste on all sinks.

## 2.5 LAB SINKS (LS-X)

- A. Manufacturers:
  1. Kewaunee
  2. Fisher Hamilton Industries
  3. Total Lab Solutions
  4. Durcon
  5. LOC Scientific
- B. Fixture Trim Manufacturers:
  1. Chicago Faucet Co.



- C. Supply Fittings Manufacturers:
  - 1. McGuire.
  - 2. T&S Brass.
- D. Drop-in Type Sinks:
  - 1. Furnished by others (casework supplier)
- E. Provide stainless steel strainer, outlet, standpipe overflow, and stopper for all sinks unless otherwise specified.
- F. Provide tailpieces and trap compatible with waste piping systems for all sinks unless otherwise specified.
- G. Provide units that comply with SEFA 7, Laboratory Fixtures. Provide Chicago Model 930 CP -317 faucet & fittings or as indicated on Drawings, complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
- H. Provide Chicago Model 982-909CAGCP turret or as indicated on Drawings, complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
- I. Finish: Polished chrome on brass body with a clear acid and solvent-resistant epoxy coating unless specified otherwise.

J. Equip valve handles with color coded plastic index buttons as follows:

Service	Indexing	Button Color	Lettering Color
Cold Water (Potable)	CW	Green	White
Hot Water (Potable)	HW	Red	White
Lab Air	AIR	Orange	Black
Natural Gas	GAS	Dk. Blue	White
Vacuum	VAC	Yellow	Black
Deionized Water	DI	White	Black
Carbon Dioxide	CO2	Pink	Black
Reverse Osmosis Water	RO	White	Black
Argon	AR	Violet	White
Helium	HE	Black	White
Hydrogen	H2	Pink	Black
Specialty Gas	SG	Lt. Blue	Black

- Trim Manufacturers:
- 1. Chicago Faucets
  - 2. Zurn

K. Preparation: Provide openings, accesses, cutouts, etc., in casework units and tops as necessary to permit installation of fittings at the Project Site.

**2.6 ELECTRIC DRINKING FOUNTAIN**

- A. Manufacturers:
  - 1. Elkay Mfg.

2. Halsey Taylor
- B. Supply Fittings Manufacturers:
  1. McGuire
  2. T&S Brass
- C. All electric water coolers shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Fountain: (EDF-1)
  1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Indoor & outdoor install compatible. Halsey Taylor Model HTHBHVR8BL-NF (Non-Filtered).
  2. Capacity: 8.0 gph of water with inlet at 50 degrees F drinking water, based on 80 degree F inlet water and room temperature of 90 degrees Fahrenheit.
  3. Electrical: 115V/60Hz
  4. Provide cane touch apron.

## **2.7 LAVATORY and SINK INSULATION KIT**

- A. Manufacturers:
  1. Truebro/IPS
  2. Zurn
- B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

## **2.8 SHOWERS (Regular) – (SH-1)**

- A. Manufacturers:
  1. Acorn
  2. Bradley
- B. SH-1: ASME A112.18.1; concealed shower supply with pressure balanced or thermostatic mixing valves, integral service stops, chrome plated vandal-proof institutional head with integral wall mounting flange, built-in 1.5 gpm flow, and escutcheon. Acorn – SV16-LVR – 519 - MSH - F1.5 or provide as indicated on plumbing fixture schedule.

## **2.9 SHOWERS (ADA) – (SH-2)**

- A. Manufacturers:
  1. Acorn.
  2. Bradley

- B. SH-2 ADA: ASME A112.18.1 and ASSE 1016-2011; concealed shower supply with pressure balanced and thermostatic mixing valves, integral service stops, hand held shower ( ) with 69 inch metal clad hose and 24 inch glide mounted on right hand side ( ), flow rate 1.5 GPM. ACORN – SV16-LVR – HHC15 - HSSH - HHSE - IVB – SB – PK or provide as indicated on plumbing fixture schedule.

**2.10 EMERGENCY EYE AND FACE WASH (EW-2)**

- A. Provide at clinic sink.
- B. Manufacturers:
  - 1. Encon Safety Products
  - 2. Bradley
  - 3. Chicago
- C. ANSI Z358.1: Integrated in the casework, Bradley S19-460EFW deck-mounted hand-held hose spray with dual spray heads. Perforated ABS plastic spray heads and soft-flow dual spray heads. Include protective spray head cover. Chrome-plated brass with extended handle stays open once handle is squeezed. 8' (2438mm) yellow reinforced thermoplastic hose with 3/8" NPT male thread. Burst strength of 450 PSI. 6" minimum distance from wall.
  - 1. Provide and install emergency eye and face wash at clinic, coordinate with architecture drawings and casework clearances.
- D. Single eyewashes shall not be connected to the intrusion detection system.
- E. Tempered water: Provide and install Navigator S19-2000 EFX8 Thermostatic mixing valve per ANSI Z358.1-2014

**2.11 EMERGENCY COMBINATION SHOWER WITH EYE AND FACE WASH (EW-1)**

- A. Manufacturers:
  - 1. Encon Safety Products
  - 2. Bradley
  - 3. Chicago
- B. Barrier Free, all stainless steel construction, corrosion resistant, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, stainless steel flag handle and floor flange, 1 ¼" IPS Schedule 40 stainless steel pipe and fittings, 1" IPS and ½" IPS U.S. made stainless steel stay open ball valves, and polished stainless steel pull rod. Unit shall have (4) polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Unit shall include ANSI compliant sign.
- C. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 – 2004, and come with a full 2-year warranty.
- D. Fixture:
  - 1. (EW-1): Guardian Equipment GBF1909SSH-GC (orange) For Central Plant and unfinished area.

- E. Alarm Option:
  - 1. AP275-200 alarm unit, with light and horn. (blue color light) Light and horn shall be installed in the mechanical room (120 VAC, 0.5 AMP).
  - 2. Locate the blue light above in mechanical room where emergency shower is installed. Provide one light per shower/valve configuration. Model AP280-230MOD (drawing KTYSD-4) w/ blue light (120v/1/60hz – 0.11 amp) for GBF 1909SSH-GC. Connect to existing intrusion system
- F. Hot water Option: TMV G3800LF Thermostatic mixing valve per ANSI Z358.1-2014.
- G. Supply and Waste Piping: 1-1/4 inch galvanized steel pipe pedestal with floor flange.
- H. Furnish universal emergency sign.

## 2.12 SERVICE SINKS (SS-1)

- A. Manufacturers:
  - 1. Fixture Manufacturers:
    - a. Stern Williams
  - 2. Fixture Trim Manufacturers:
    - a. Stern Williams
- B. SS-1: 12" corner type w/drop front, bowl 36 x 36 x 12 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer, floor mounted. Stern Williams Model SBC-1750 or provide as indicated on plumbing fixture schedule.
- C. Accessories:
  - 1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.
  - 2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.
  - 3. Mop hanger. Stern Williams Model T-40.
  - 4. Or provide as indicated on plumbing fixture schedule

## 2.13 FLOOR DRAINS

- A. Manufacturers:
  - 1. Josam Mfg.
  - 2. Zurn
  - 3. Smith
  - 4. Wade
  - 5. Conrad Industries

- B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- C. Floor Drain (FD-2): ASME A112.21.1; Top square floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable heavy duty square nickel-bronze strainer with removable perforated sediment bucket. Zurn ZN-415-SZ1-DP (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- D. Floor Drain (FD-3): ASME A112.21.1; Cast iron flanged receptor with seepage holes, acid resistant coated interior and indirect waste drain, nickel bronze rim and secured grate. Secondary strainer or sediment bucket with. Zurn ZN-1970-KC-11 (Vandal-Proof Secured Top option is prohibited) with 4" funnel drain for freezer drain only or provide as indicated on plumbing fixture schedule.
- E. Floor Drain (FD-4): ASME A112.21.1; medium duty drains with 8-1/2" round top, duco cast iron body and flashing collar with cast iron bar. Zurn Z-550 (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- F. Floor Drain (FD-5): ASME A112.21.1; Large capacity suspended sediment bucket, fabricated steel body with galvanized coating inside and outside, cast iron grate, stainless steel ported bucket with mesh screen and lift bar. Zurn Z-539 (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- G. Hubdrain (HD-1): Zurn Z-551 Series (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- H. Hubdrain (HD-2): Stainless Steel. Zurn Z-1726 Series (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.

## 2.14 FLOOR SINKS

- A. Manufacturers:
  - 1. Josam Mfg.
  - 2. Zurn
  - 3. Smith
  - 4. Wade
  - 5. Conrad Industries
- B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- C. FS-2: Zurn ZN-1900-KC, 12 inches, 3/4 grate (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.
- D. FS-3: Zurn ZN-1900-KC, 12 inches, 1/2 grate (Vandal-Proof Secured Top option is prohibited) or provide as indicated on plumbing fixture schedule.

## 2.15 TRAP SEAL PRIMERS

- A. Trap Seal Primers-Flush Valve Type (TP-2)
  - 1. Vacuum breaker trap primer attached to water closet flush valve; Precision Plumbing Products similar to Sloan VBF-72-A.
- B. Trap Seal Primers-electronic Type (TP-E)
  - 1. Vacuum breaker trap primer attached to water supply manifold; Precision Plumbing Products similar to Zurn Z-1020 with copper waterway.
  - 2. Accessories:
    - a. Slow closing 24 VAC solenoid valve.
    - b. 120 – 24 VAC transformer.
    - c. Brass atmospheric vacuum breaker.
    - d. Copper connection outlets.

## 2.16 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
  - 1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers
- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
  - 1. Josam Mfg.
  - 2. Zurn
  - 3. Smith
  - 4. Wade
  - 5. Conrad Industries
- D. Floor, Outdoors (COTG): Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.
- E. Floor, Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured without vandal proof screw option. Jay R. Smith Model 4420-U.
- G. Floor, Stainless Steel Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

## 2.17 ROOF DRAINS

- A. Roof Drain (RD-1):
1. Assembly: ASME A112.21.2M.
  2. Body: Lacquered cast iron with sump.
  3. Strainer: Removable aluminum dome without vandal proof screws.
  4. Accessories: Coordinate with roofing type, provide all required accessories:
    - a. Membrane flange and membrane clamp with integral gravel stop.
    - b. Under deck ring with wide flange.
    - c. Roof sump receiver.
    - d. Waterproofing flange.
    - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
  5. Model:
    - a. Josam – 21500-AE-CR-1-26
    - b. J. R. Smith – 1015AD-C-R
    - c. Zurn – ZA100-C-EA-R
    - d. Wade – 3000-AE-189
- B. Overflow Roof Drain (OD-1):
1. Assembly: ASME A112.21.2M.
  2. Body: Lacquered cast iron with sump.
  3. Strainer: Removable aluminum dome without vandal proof screws.
  4. Waterdam extended to two (2) inches above flood elevation.
  5. Accessories: Coordinate with roofing type:
    - a. Membrane flange and membrane clamp with integral gravel stop.
    - b. Adjustable under deck clamp.
    - c. Roof sump receiver.
    - d. Waterproofing flange.
    - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
  6. Model:
    - a. Josam – 21500-AE-CR-1-26
    - b. J. R. Smith – 1015AD-C-R
    - c. Zurn – ZA100-C-EA-R
    - d. Wade – 3000-AE-189

## 2.18 HOSE BIBS

- A. Manufacturers:
1. Woodford
  2. Zurn Industries
- B. HB-1:
1. Manufacturers: Woodford Model B24 or provide as indicated on plumbing fixture schedule.

2. Interior: Polish brass, anti-siphon, vacuum breaker, enclosed in flush mounted wall box and adjustable brass nut with deep stem guard.
- C. HB-2:
1. Manufacturers: Woodford Model B65, or provide as indicated on plumbing fixture schedule.
  2. Interior: Polish brass Bronze, automatic draining freezeless wall hydrant, single check hose connection anti-siphon vacuum breakers, hydrants drain as handle shut off , permanent type brass valve body with hemispherical seating surface.
- D. HB-3:
1. Manufacturers: Woodford Model 24 or provide as indicated on plumbing fixture schedule.
  2. Interior: Polish brass, anti-siphon, vacuum breaker and adjustable brass nut with deep stem guard.

## 2.19 WALL HYDRANTS

- A. Manufacturers:
1. Woodford.
  2. Zurn Industries
- B. Exterior Wall Hydrant (WH-1):
1. Woodford RB65, Non-Freeze, or provide as indicated on plumbing fixture schedule.
  2. ASSE 1019; Chrome, non-freeze, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.
- C. Kitchen Yard Hydrant (WH-2):
1. Woodford HCB67, ASSE 1019, or provide as indicated on plumbing fixture schedule.
  2. Lockable box type, non-freeze hot and cold mixer, chrome finish with permanent type brass valve body with hemispherical seating surface, automatic draining and hose connection, backflow preventer and check valve.

## 2.20 ROOFTOP HYDRANTS

- A. Roof Hydrant (RH-1):
1. MAPA Products Model MPH-24-FP:24/9. Refer to plumbing details for additional information.
  2. The hydrant Features:
    - a. Hydrant shall drain into an integral stainless steel canister, below the roof line, to prevent freezing.
    - b. Provide 1052 backflow preventer.
    - c. Provide pump head style which meets or exceeds ADA requirements.
  3. All necessary mounting hardware for proper installation on a commercial roof is supplied, including a 2 degree shim for pitch adjustment.



4. Roof hydrant shall not require a drain line for frost protection.
5. Provide and install easily accessible and concealed shut-off valve in lay-in ceiling plenum or as indicated on plans.

### **2.21 RECESSED VALVE BOX**

- A. Manufacturers: Guy Gray.
- B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.
- C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

### **2.22 DOWNSPOUT OVERFLOW**

- A. Nozzle Style:
  1. Manufacturers: Jay R. Smith 1770 Series or provide as indicated on plumbing fixture schedule.
  2. Product Description: Cast bronze body and wall flange round with offset bottom section.
- B. Hinged Cover Style:
  1. Manufacturers: Jay R. Smith 1775-U Series or provide as indicated on plumbing fixture schedule.
  2. Product Description: Fabricated Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

### **3.2 PREPARATION**

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

### **3.3 INSTALLATION**

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.

- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.
- H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.
- M. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- N. Bolt carriers to the floor.
- O. All sinks shall have an offset rear centered drain.
- P. One-piece Faucets to extend 2 inches beyond backsplash of lavatory and shall be of the three-hole variety, coordinate with lavatories.
- Q. All Emergency Showers shall have flow switch with local alarm and tie into building security system to notify CFISD Police Department when shower is activated. At science labs, a blue strobe shall be installed in the corridor outside the classroom to indicate shower activation. For renovation projects, use a drench hose type eyewash adjacent to the sink in the Clinic. Specify Bradley S19-460 EFW for all grade levels. For new projects, use a separate rough-in for a wall mounted eyewash.
- R. Provide trap primer connection on the back side of the flush valve. (No trap primers on lavatories.)
- S. Use electric trap primers at central plant and areas where five or more floor drains are tied in. All others to be tapped from back of flush valve.
- T. The hot and cold water connections on all kitchen 3-compartment sink faucets shall be 3/4" copper pipe from the wall to the faucet, with 3/4" ball valves easily accessible below the sink. No 1/2 x 3/8 angle stops and flexible connectors allowed.

- U. All kitchen commercial garbage disposers shall be connected to the sanitary sewer system (not grease waste). Minimum 3" pipe underground for disposer waste line. Disposers shall not discharge into floor sinks or hub drains. Disposer waste shall connect at wall with a clean-out installed both upstream and downstream of the P-trap.

### **3.4 INTERFACE WITH OTHER PRODUCTS**

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

### **3.5 ADJUSTING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.
- C. Defected materials and equipment shall be corrected at no cost to Owner. Defects shall include, but not limited to, the following:
  - 1. Noisy operation
  - 2. Noticeable deterioration of finish
  - 3. Leakage of water
  - 4. Foul odor emittance from fixture

### **3.6 CLEANING**

- A. Clean plumbing fixtures and equipment.

### **3.7 PROTECTION OF INSTALLED CONSTRUCTION**

- A. Do not permit use of fixtures before final acceptance.

**END OF SECTION 22 40 00**

## **SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

#### **1.3 QUALITY ASSURANCE**

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

#### **1.4 COORDINATION WITH OTHER TRADES**

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

## 1.5 DRAWINGS

- A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

## 1.6 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
  - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
  - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
  - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.
  - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

## 1.7 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a

complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
  - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
  - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
  - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
  - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
  - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
  - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
  - 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

## 1.8 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

## **1.9 INTERFERENCE DRAWINGS**

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

## **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

## **1.11 GENERAL ELECTRICAL REQUIREMENTS**

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.



## **1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).
- C. Electric Motors:
  - 1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.
  - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
  - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
  - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
  - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
  - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
  - 7. Where possible, motors shall be factory mounted.

## **PART 2 – PRODUCTS – NOT USED**

## **PART 3 - EXECUTION**

### **3.1 OWNER INSTRUCTION - GENERAL**

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

- D. Refer to individual equipment specifications for additional training requirements.

**END OF SECTION 23 05 00**

## **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

#### **1.3 REFERENCES**

- A. American Bearing Manufacturers Association:
  - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
  - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

#### **1.4 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

- C. For extended outdoor storage, remove motors from equipment and store separately.

## PART 2 - PRODUCTS

### 2.1 ELECTRIC MOTORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Baldor
  2. Marathon
  3. General Electric
  4. Weg
  5. A.O. Smith
  6. Century Reliance
  7. Teco Westinghouse
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated. Motors shall be equipped with maintenance free microfiber shaft grounding ring. Provide Aegis SGR or prior owner approved equal.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
1. Service Factor: 1.15
  2. **Enclosure: Totally-Enclosed, Fan-Cooled (TEFC) or Totally Enclosed Air-Over (TEAO).**
  3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  4. Insulation System: NEMA Class F.
  5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
  6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 150,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
  7. Sound Power Levels: Conform to NEMA MG 1.
  8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.

- 9. All motors 3 phase operated by variable frequency drive must be equipped with a maintenance free, conductive microfiber, carbon fiber shaft grounding rings. Designed for the life of the motor. Provide AEFIS SGR or equal.
- F. Single Phase Motors:
  - 1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.
  - 2. Service Factor: 1.35.
- G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

**2.2 SOURCE QUALITY CONTROL**

- A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:
  - 1. Starters and motors specified as part of a packaged piece of equipment.
  - 2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
  - 3. Variable speed controllers for variable volume air handling units and cooling towers.
- B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.
- C. Provide a tabulation of matched motors and starters provided under Division 23.
- D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.
- E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency
1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5

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<b>5</b>	89.5	89.5	86.5	<b>5</b>	89.5	89.5	88.5
<b>7.5</b>	90.2	91.0	88.5	<b>7.5</b>	91.0	91.7	89.5
<b>10</b>	91.7	91.7	89.5	<b>10</b>	91.0	91.7	90.2
<b>15</b>	91.7	93.0	90.2	<b>15</b>	91.7	92.4	91.0
<b>20</b>	92.4	93.0	91.0	<b>20</b>	91.7	93.0	91.0
<b>25</b>	93.0	93.6	91.7	<b>25</b>	93.0	93.6	91.7
<b>30</b>	93.6	94.1	91.7	<b>30</b>	93.0	93.6	91.7
<b>40</b>	94.1	94.1	92.4	<b>40</b>	94.1	94.1	92.4
<b>50</b>	94.1	94.5	93.0	<b>50</b>	94.1	94.5	93.0
<b>60</b>	94.5	95.0	93.6	<b>60</b>	94.5	95.0	93.6
<b>75</b>	94.5	95.0	93.6	<b>75</b>	94.5	95.4	93.6
<b>100</b>	95.0	95.4	93.6	<b>100</b>	95.0	95.4	94.1
<b>125</b>	95.0	95.4	94.1	<b>125</b>	95.0	95.4	95.0
<b>150</b>	95.4	95.8	94.1	<b>150</b>	95.8	95.8	95.0
<b>200</b>	95.4	95.8	95.0	<b>200</b>	95.8	96.2	95.4

**PART 3 - EXECUTION**

**3.1 REQUIREMENTS**

- A. All equipment shall be installed in accordance with the manufacturer’s recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor’s price shall include all items required as per manufacturer’s requirements.

**3.2 INSTALLATION**

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.
- E. All motors smaller than 10 H.P., wire nuts are acceptable. Motors 10 H.P. and greater shall be provided and installed with copper alloy split bolt connectors or insulated multi-tap connectors, insulated with rubber and electrical tapes; wire nuts are not acceptable.

**END OF SECTION 23 05 13**

## **SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Pressure gages.
  - 2. Pressure gage taps.
  - 3. Stem type thermometers.
  - 4. Dial thermometer.
  - 5. Thermometer supports.
  - 6. Test plugs.
  - 7. Bladder-type expansion tanks.
  - 8. Air vents.
  - 9. Combination Dir and Air Separators.
  - 10. Strainers.
  - 11. Flow controls / Balancing Valves
  - 12. Relief valves.
- B. Related Sections:
  - 1. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
  - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
  - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
  - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
  - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of components and instrumentation.
- B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

#### **1.5 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Accept on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

#### **1.8 WARRANTY**

- A. Furnish one (1) year manufacturer warranty for piping specialties.

### **PART 2 - PRODUCTS**

#### **2.1 PRESSURE GAGES**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Weiss
  - 2. Marsh Bellofram
  - 3. Weksler
  - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
  - 1. Case: Stainless steel.
  - 2. Bourdon Tube: Phosphor bronze.
  - 3. Dial Size: 4-1/2 diameter.
  - 4. Mid-Scale Accuracy: One (1) percent.



5. Scale: Psi.

## 2.2 PRESSURE GAGE TAPS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide the following:
  - 1. Pete's Plug
- B. Needle Valve: Brass, 1/4-inch NPT for minimum 300 psi.
- C. Ball Valve: Brass 1/4-inch NPT for 250 psi.
- D. Pulsation Damper: Pressure snubber, brass with 1/4-inch NPT connections.
- E. Siphon: Brass, 1/4-inch NPT angle or straight pattern.

## 2.3 STEM TYPE THERMOMETERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Terice
  - 2. Weiss
- B. Thermometer: Rigid 90°F angle, blue colored, organic, mercury fill, Valox case, brass stem, ½ NPT brass thermowell, acrylic window, lens front, magnifying tube type, scale face of aluminum, white background with black graduations and markings
  - 1. Scale Size: 5-1/2" long.
  - 2. Molded Valox - V-shaped black case.
  - 3. Window: Double Strength Glass
  - 4. Stem: Brass, 1/2-inch NPT, and 2 inches long.
  - 5. Accuracy: ±2% of full scale ASME B40.4 Grade A.
  - 6. Calibration: Both degrees Fahrenheit and degrees Celsius.

## 2.4 DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Terice
  - 2. Weiss
- B. Thermometer: 300 stainless steel, hermetically sealed, bimetallic, silicone dampened on ranges to 300°F coil, adjustable angle, ½ NPT, double strength glass window, balanced, black finish pointer, dial face of aluminum, white background with black and blue graduations and markings.
  - 1. Dial Size: 5-inch diameter dial.
  - 2. Window: Double strength glass.
  - 3. Stem: 300 Stainless Steel, ¼" diameter NPT, 2-1/2" long.

4. Length of Capillary: Minimum five (5) feet.
5. Accuracy:  $\pm 1\%$  of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

## 2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: Three (3) inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  1. Pete's Plug
- B. 1/4-inch NPT or 1/2-inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
  1. Neoprene core for temperatures up to 200 degrees F.
- C. Provide extended stem to accommodate insulation; cap opening must extend past insulation.
- D. Test Kit:
  1. Carrying case, internally padded, and fitted containing:
    - a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
    - b. Two gage adapters with 1/8-inch probes.
    - c. Two 1-1/2-inch dial thermometers.

## 2.7 BLADDER-TYPE EXPANSION TANKS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  1. Wheatly
  2. Bell and Gossett
  3. Wessels
  4. Armstrong
  5. Taco
- B. Tank: Welded steel, rated for minimum 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  1. Size: As indicated on Drawings.

- C. Bladder: Heavy duty butyl-FDA approved.
- D. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24 inches length, long enough to cover tank for two (2) inches above bottom to two (2) inches below top.
- E. Quick Connect Air Inlet:
  - 1. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.
- F. Automatic Cold-Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.
- G. Hot Water Heating System:
  - 1. Select expansion tank pressure relief valve at 20 psi maximum.
  - 2. Set pressure reduction valve at select 12 psi.
- H. Chilled Water System:
  - 1. Select expansion tank pressure relief valve at 25 psi maximum.
  - 2. Set pressure reduction valve at 12 psi.
- I. Do not insulate ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

## 2.8 AIR VENTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Armstrong
  - 2. ITT
  - 3. Sarco
- B. Manual Type: Short vertical sections of two (2) inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float Type:
  - 1. Brass, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
  - 1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

## 2.9 COMBINATION DIRT / AIR SEPARATORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Taco – High Velocity 4900
  - 2. Spirotherm – Series HV
  - 3. Thrush – High Velocity
- B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- C. Dirt & Air Separator: Each separator must be designed with a blow-down valve, skim valve, and automatic air vent. The separator must also utilize in its design a stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure.

## 2.10 STRAINERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Armstrong
  - 2. Bell & Gossett
  - 3. Mueller
  - 4. Crane
  - 5. Zurn
  - 6. Keckley
- B. Size two (2) inch and Smaller:
  - 1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- C. Size 2-1/2 inch to four (4) inch:
  - 1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.
- D. Size five (5) inch and Larger:
  - 1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

## 2.11 FLOW CONTROLS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Bell and Gossett
  - 2. Nibco

3. ITT Hoffman
  - B. Construction: Ametal® Brass or bronze body, y-pattern, with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain.
  - C. Calibration: Factory set to control flow within five (5) percent of design flow over entire operating pressure.
  - D. Control Mechanism: Stainless steel or nickel-plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
  - E. Accessories: In-line strainer on inlet and ball valve on outlet.
  - F. Provide extended handle stems to accommodate insulation.

## **2.12 RELIEF VALVES**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  1. Bell and Gossett
  2. McDonnell-Miller
- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION - THERMOMETERS AND GAGES**

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump, pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometers in air duct systems on flanges.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- G. Locate duct-mounted thermometers minimum ten (10) feet downstream of mixing-dampers, coils, or other devices causing air turbulence.
- H. Coil and conceal excess capillary on remote element instruments.

- I. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

### **3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES**

- A. Locate test plugs adjacent to pressure gages and pressure gage taps and as indicated on Drawings.
- B. Install manual air vents at system high points.
- C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide drain and hose connection with valve on strainer blow down connection.
- F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Equipment relief valve capacity not to exceed rating of connected equipment.
- K. Pipe relief valve outlet to nearest floor drain.
- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- M. Insulate all volume tanks to match adjacent intake and discharge piping and jacketing requirements.

**END OF SECTION 23 05 19**

## **SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Globe valves.
  - 2. Ball valves.
  - 3. Plug valves.
  - 4. Butterfly valves.
  - 5. Swing check valves.
  - 6. Spring loaded check valves.
  - 7. Flanges and unions.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.
- B. Welders Certificate: Include welder's certification of compliance with ASME Section IX.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

#### **1.5 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install valves underground when bedding is wet or frozen.

## 1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for valves.

## 1.9 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve.

## PART 2 - PRODUCTS

### 2.1 HEATING AND COOLING VALVES

#### A. Globe Valves:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. Crane.
  - b. Dezurik.
  - c. Nibco.
  - d. Keystone.
  - e. Milwaukee Valve.
2. Two (2) inches and Smaller: Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw, renewable plug disc and stainless-steel seat ring, solder, or threaded ends.
3. Two (2) inches and Larger: Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

#### B. Ball Valves:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. Crane
  - b. Dezurik
  - c. Nibco
  - d. Keystone
  - e. Milwaukee Valve
  - f. Kitz (hot water only)
  - g. Keckley
2. Two (2) inches and Smaller: Bronze two-piece body, full port 316 stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle with balancing stops, solder, or threaded ends with union.
3. Two (2) inches and Larger: Cast steel body, 316 stainless steel ball and stem, Teflon seat and stuffing box seals, lever handle, or gear drive hand-wheel for sizes ten (10) inches and larger, flanged.
4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive material. Also provide a protective sleeve to prevent damage to vapor seal when valve adjustment is made. Memory stops shall be adjustable after insulation is applied.



C. Butterfly Valves:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. Crane
  - b. Hammond
  - c. Dezurik
  - d. Nibco
  - e. Stockham
  - f. Grinnell
  - g. Keystone – 2" or larger only
2. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
3. Disc: Aluminum bronze.
4. Operator: 10 position lever handle on sizes two and half (2 1/2) inches to four (4) inches.
5. Hand-wheel and gear drive on sizes larger than six (6) inches.

D. Swing Check Valves:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. Mission Duocheck
  - b. Nibco
  - c. Keystone
  - d. Milwaukee Valve
  - e. Keckley
2. Two (2) and Smaller: Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder, or threaded ends.
3. Two and a half (2-1/2) inches and Larger: Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends or Ductile iron body, 316 stainless steel clapper, synthetic rubber bumper/seal and bonnet.

E. Spring Loaded Check Valves:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. Nibco
  - b. Mission Duocheck
  - c. Dezurik
  - d. Keystone
  - e. Milwaukee Valve
2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

3. Two (2) and Smaller: Red bronze body, 301 stainless steel spring-actuated disc, EPDM o-ring, 300 series stainless steel stem and spring, in-line, lift-type check valve.

## **2.2 FLANGES AND UNIONS**

- A. Unions for Pipe two (2) inches and Smaller:
  1. Ferrous Piping: 150 psig malleable iron, threaded.
  2. Copper Pipe: Bronze, soldered or push-to-connect joints.
- B. Flanges for Pipe two (2) inches and Larger:
  1. Ferrous Piping: 150 psig forged steel, slip-on.
  2. Copper Piping: Bronze.
- C. Gaskets: 1/16-inch-thick preformed neoprene.
- D. Accessories: Stainless Steel bolts, nuts, and washers.
- E. Dielectric Connections:
  1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
  2. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- D. Install butterfly or ball shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- E. Install calibrated-orifice, balancing valves at each branch connection to return main.
- F. Install globe or ball valves for throttling, bypass, or manual flow control services.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide flow controls in water re-circulating systems.
- I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- J. Use 1 1/4" inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

- K. Install valves in accessible locations to permit removal of bonnet.
- L. Install valve stems in vertical position. Valve stems installed in horizontal position shall be no less than 30 degrees from horizontal.

**END OF SECTION 23 05 23**

## **SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:

- 1. Pipe hangers and supports.
- 2. Hanger rods.
- 3. Inserts.
- 4. Flashing.
- 5. Equipment roof curbs and support rails.
- 6. Sleeves.
- 7. Mechanical sleeve seals.
- 8. Formed steel channel and angle.
- 9. Equipment bases and supports.
- 10. Portable roof pipe supports.

- B. Related Sections:

- 1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- 2. Division 7 - Thermal and Moisture Protection.

#### **1.3 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Pipe stands.
  - 4. Equipment supports.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.5 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

**1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

**1.8 WARRANTY**

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

**PART 2 - PRODUCTS**

**2.1 PIPE HANGERS AND SUPPORTS**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Carpenter & Paterson Inc.
  - 2. Flex-Weld, Inc.
  - 3. Globe Pipe Hanger Products Inc.
  - 4. Michigan Hanger Co.
  - 5. B-Line Systems
  - 6. Carpenter & Patterson Inc.
  - 7. Anvil International
  - 8. Piping Technology & Products
  - 9. Grinnell
- B. Hydronic Piping:
  - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
  3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
  4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
  5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
  6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
  7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
  8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
  9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
  10. Vertical Support: galvanized Steel riser clamp.
  11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
  14. Copper Pipe Support: Copper-plated, carbon steel ring.
  15. Hydronic Piping shall not have support brackets welded to hydronic piping.
- C. Roof Mounted Hydronic Piping:
1. Refer to Division 7 –for hanger requirements and approved manufacturers.
- D. Exterior Floor Mounted Hydronic Piping:
1. Refer to pipe stanchion details for exterior floor mounted piping support.

## 2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

### **2.3 INSERTS**

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

### **2.4 FLASHING**

- A. In accordance with Division 7 - Thermal and Moisture Protection.

### **2.5 HOODED CURB**

- A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

### **2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS**

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. The Pate Co.
  - b. Custom Curb, Inc.
  - c. Roof Products, Inc.
- E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

### **2.7 SLEEVES**

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.

- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

## 2.8 MECHANICAL SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Thunderline Link-Seal, Inc.
  2. NMP Corporation
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## 2.9 FORMED STEEL CHANNEL AND ANGLE

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Allied Tube & Conduit Corp.
  2. B-Line Systems
  3. Midland Ross Corporation, Electrical Products Division
  4. Unistrut Corp.
- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.
- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.
- D. Structural members to be loaded within manufacturers design limitations and published data.

## 2.10 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete.
- B. **Chillers shall be set on concrete 12"x12" runners extending 6" beyond length of each side of chiller.**
- C. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
1. Hot Water Boilers: four (4) inches.
  2. Floor Mounted Pumps: four (4) inches.
  3. Floor Mounted Water Volume Tanks: four (4) inches.
  4. Air Handling Units: four (4) inches.
  5. Water Heaters: four (4) inches.
  6. Water Softeners: four (4) inches.
  7. Air Compressor: four (4) inches.
  8. Floor Mounted Expansion Tanks: four (4) inches.
  9. Floor Mounted chemical feeder tanks: four (4) inches.
  10. Floor Mounted Fans: four (4) inches.
  11. Condensing Units: four (4) inches.



12. Heat Pump Units: four (4) inches.
- D. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

## 2.11 PORTABLE ROOF PIPE SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  1. PHP systems / design.
- B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model SS6000P with height adjustable crossbar and clevis hangers. Product specifications:
  1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
  2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
  3. Height: Adjustable.
  4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
  5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolt & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
  6. Required accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.
- C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:
  1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
  2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
  3. Hardware: 1/2" threaded rods (12" high); 1/2" nuts & washers, hot- dipped galvanized.
  4. Height: Adjustable.
  5. Required accessories: Strut clamps and protection pads.
  6. Hot dipped galvanized threaded rods, nuts and washers.
- D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.

1. Material: Porous rubber.
2. Weight: 2 lbs.
3. Dimensions: 18" square X ½" thick.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

#### **3.2 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

#### **3.3 STRUCTURAL STEEL**

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

#### **3.4 CUTTING AND PATCHING**

- A. In accordance with Division 7 - Thermal and Moisture Protection

#### **3.5 FIRESTOPPING**

- A. In accordance with Division 7 - Thermal and Moisture Protection.

#### **3.6 FIRESTOPPING ACCESSORIES**

- A. In accordance with Division 7 - Thermal and Moisture Protection.

#### **3.7 INSTALLATION - INSERTS**

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

### **3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS**

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

### **3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS**

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

### **3.10 INSTALLATION - FLASHING**

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

- C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

### **3.11 INSTALLATION - SLEEVES**

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

### **3.12 INSTALLATION - FIRESTOPPING**

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
  - 1. Seal opening at floor, wall, and partition as follows:
    - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Pack void with backing material.
    - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall and partition floor as follows:
  - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
  - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

### **3.13 INSTALLATION - ACCESS DOORS**

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.
- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
  1. Plastic Surfaces: Milcor Style K.
  2. Ceramic Tile Surface: Milcor Style M.
  3. Drywall Surfaces: Milcor Style DW.
  4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

### **3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES**

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17” circular bases removing any loose gravel and foreign matter before setting 17” circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer’s system under each 17” circular bases. Do not adhere to the roof system or to circular bases.

### **3.15 FIELD QUALITY CONTROL**

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

### **3.16 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

**3.17 PROTECTION OF FINISHED WORK**

- A. Protect adjacent surfaces from damage by material installation.

**3.18 PIPE HANGERS**

- A. Minimum hanger rod size shall be 1/2".
- B. Maximum hanger rod spacing shall not exceed 8'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.
- C. For trapeze supports provide a minimum of (2) two 1/2" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.
- D. Beam clamps are not acceptable.

**END OF SECTION 23 05 29**

## **SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Vibration isolation for building mechanical systems.
- B. Related Sections:
  - 1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
  - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Mason Industries model numbers are listed for identification only.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Mason Industries
  - 2. Kinetics Noise Control
  - 3. Amber / Booth
  - 4. Vibration Eliminator
  - 5. Korfund
  - 6. Metraflex

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed, and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.
- E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.

- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.
- I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.
- J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
  - 1. Offices  
Executive: 30  
Conference rooms: 30  
Private: 35  
Open-plan areas: 35  
Computer/business machine areas: 40  
Public circulation: 40
  - 2. Schools  
Lecture and classrooms: 30  
Open-plan classrooms: 35
  - 3. Libraries: 25
  - 4. Theaters  
Theater: 25  
Stage house: 25  
Trap room: 25  
Orchestra pit: 25  
Rehearsal rooms: 25



Teaching studios: 30  
Practice rooms: 30  
Ensemble rooms: 30  
Shop: 45

#### **1.4 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

#### **1.5 QUALITY ASSURANCE**

- A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection, and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

#### **1.6 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

### **PART 2 - PRODUCTS**

#### **2.1 VIBRATION ISOLATOR TYPES**

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the

pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

### **2.3 FLEXIBLE PIPE CONNECTIONS (CHILLERS AND BASE-MOUNTED PUMPS)**

- A. Type SFDEJ, SFEJ, SFDCR or SFU with Control Rods CR (required): Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- B. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

### **3.2 PIPING ISOLATION**

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

### 3.3 INSTALLATION

- A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- E. Install Work in accordance with ASME B31.9.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

- I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE
AIR HANDLING UNITS (NOTE 2) FLOOR MOUNTED TO 15 HP 20 HP & OVER SUSPENDED UP TO 15 HP 20 HP & OVER HIGH PRESSURE FAN SECTION (NOTE 1) UP TO 30 HP 40 HP & OVER	SLF SLF 30N PC30N SLF/W BI SLF/W BI	0.75 1.5 1 1.75 1.5 2.5	- - - - RBMK RBMK	SLF SLF 30N PC30N SLF/W BI SLF/W BI	0.75 0.75 1 1 0.75 1.5	- - - - RBMK RBMK
CENTRIFUGAL FANS CL. I & II UP TO 54-1/2" W.D. Up to 15 HP 20-50 HP 60 HP & OVER CL. I & II 60" W.D. & OVER/ALL CL. III FANS UP TO 15 HP 20-50 HP 60 HP & OVER	SLF SLF SLF SLF/W BI SLF/W BI SLF/W BI	0.75 1.5 2.5 1.5 2.5 2.5	WF RBMK RBMK RBMK RBMK RBMK	SLF SLF SLF SLF/W BI SLF/W BI SLF/W BI	0.75 0.75 1.5 0.75 1.5 1.5	WF WF WF RBMK RBMK RBMK
AXIAL-FLOW FANS (NOTE 1) FLOOR MTD. UP TO 15 HP 20 HP & OVER SUSPENDED (NOTE 1) UP TO 15 HO 20 HP & OVER	SLF SLF 30N PC30N	0.75 1.5 1 1.75	- - - WF	SLF SLF 30N PC30N	0.75 0.75 1 1.5	- - - -
VENT (UTILITY SETS) FLOOR MTD. SUSPENDED	SLF 30N	0.75 1	- -	SLF 30N	0.75 0.75	- -
CABINET FANS, FAN SECTIONS (NOTE 1) CL. I & II UP TO 54-1/2" W.D. Up to 15 HP 20-50 HP  SUSPENDED UP TO 15 HP	SLF SLF 30N PC30N	0.75 1.5 1 1.75	- - - -	SLF SLF 30N 30N	0.75 0.75 0.75 1.75	- - - -

20 HP & OVER							
PUMPS							
FLOOR MTD. UP TO 60 HP	SLF	1.50	RBMK	SLF	0.75	RBMK	
FLOOR MTD. 75 HP AND LARGER	SLF	2.50	RBMK	SLF	0.75	RBMK	
SUSPENDED INLINE	PC30N	1.75	-	PC30N	1.75	-	
REFRIGERATION UNITS							
RECIPROCATING	SLF	1.5	RBMK	SLF	0.75	RBMK	
COMPRSSORS	SLR/IC	1.5	-	SLF	0.75	-	
RECIPROCATING COND.	S	1.5	-	WSW	0.15	-	
UNITS & CHILLERS	SLR	1.5	RBMK	WSW	0.15	-	
HERMETIC	SLF	0.75	-	WSW	0.15	-	
CENTRIFUGALS	SLR/IC						
OPEN CENTRIFUGALS	S						
ABSORPTION MACHINES							
AIR COMPRESSORS							
TANK TYPE (HORIZONTAL TANK)	SLF	1.5	-	SLF	0.75	-	
TANK TYPE (VERTICAL TANK)	SLF	1.5	-	SLF	0.75	-	
COOLING TOWERS & CLOSED-CIRCUIT COOLERS							
UP TO 500 TONS	SLR	0.75	(1)	WSW	0.15	-	
OVER 500 TONS	SLR	2.5	(1)	WSW	0.15	-	
AIR COOLED CONDENSERS							
UP TO 50 TONS	SLR	0.75	(1)	WSW	0.15	-	
OVER 50 TONS	SLR	1.5	(1)	WSW	0.15	-	
ROOFTOP AIR CONDITIONING UNITS							
REQUIRING WEATHER SEAL	SLF	0.75	RSC/C	-	-	-	
UP TO 5000 CFM (12 TON)	SLR	1.5	MAB	-	-	-	
OVER 5000 CFM (12 TON)			RSC/C				
OTHER TYPES	SLR	1.5	MAB	-	-	-	
UP TO 25 TONS			(1)				
OVER 25 TONS			(1)				
BOILER (PACKAGE TYPE)							
ALL SIZES	SLR	0.75		WSW	0.15	-	
ENGINE DRIVEN							
GENERATORS	SLR	1.5	RBMK	SLR	0.75	-	
UP TO 60 HP	SLR	2.5	RBMK	SLR	0.75	-	
75 HO & OVER							

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.
2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

**END OF SECTION 23 05 48**

## **SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Nameplates.
  - 2. Tags.
  - 3. Stencils.
  - 4. Pipe markers.
  - 5. Ceiling tacks.
  - 6. Labels.
  - 7. Lockout devices.
  - 8. Pipe painting (if required)
- B. Related Sections:
  - 1. Section 09 91 00 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

#### **1.3 REFERENCES**

- A. American Society of Mechanical Engineers:
  - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
  - 2. District Standards for identification and color scheme.

#### **1.4 SUBMITTALS**

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.



### **1.5 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

### **1.6 QUALITY ASSURANCE**

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

### **1.7 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

## **PART 2 - PRODUCTS**

### **2.1 NAMEPLATES**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Craftmark Identification Systems.
  - 2. Safety Sign Co.
  - 3. Seton Identification Products.
  - 4. Almetek Industries.
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

### **2.2 TAGS**

- A. Plastic Tags:
  - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.
    - b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:
  - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Craftmark Identification Systems.
  - b. Safety Sign Co.
  - c. Seton Identification Products.
  - d. Almetek Industries.
2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.
    - b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

## 2.3 STENCILS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
  2. Safety Sign Co.
  3. Seton Identification Products.
  4. Almetek Industries.
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
  2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
  3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
  4. Ductwork and Equipment: 1-3/4 inches high letters.
- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

## 2.4 PIPE MARKERS

- A. Plastic Pipe Markers:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.

- b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- B. Plastic Tape Pipe Markers:
  - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.
    - b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Underground Pipe Markers:
  - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.
    - b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  - 2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

## 2.5 CEILING TACKS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Craftmark Identification Systems.
  - 2. Safety Sign Co.
  - 3. Seton Identification Products.
  - 4. Almetek Industries.
- B. Description: Steel with 3/4-inch diameter color-coded head.

## 2.6 LABELS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Craftmark Identification Systems.
  - 2. Safety Sign Co.
  - 3. Seton Identification Products.
  - 4. Almetek Industries.
- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

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## 2.7 LOCKOUT DEVICES

- A. Lockout Hasps:
  - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.
    - b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  - 2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices:
  - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
    - a. Craftmark Identification Systems.
    - b. Safety Sign Co.
    - c. Seton Identification Products.
    - d. Almetek Industries.
  - 2. Nylon device preventing access to valve operator, accepting lock shackle.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

### 3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.

- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

**3.3 IDENTIFICATION SCHEDULE**

- A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply  Condenser Water Return

- B. **PIPE PAINTING:**

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.
2. The entire fire protection piping system shall be painted red.
3. All outdoor un-insulated piping shall be painted with primer as a minimum.
4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

**C. PAINTING SCHEDULE**

<b>SYSTEM</b>	<b>COLOR</b>
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

**END OF SECTION 23 05 53**

## **SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Testing, adjusting, and balancing of air systems.
  - 2. Testing, adjusting, and balancing of Hydronic piping systems
  - 3. Testing, adjusting, and balancing of refrigerating systems.
  - 4. Measurement of final operating condition of HVAC systems.
  - 5. Sound measurement of equipment operating conditions.
  - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
  - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
- E. TAB Contractors:
  - 1. Engineered Air Balance
  - 2. Precision Air
- F. Scope of Work:
  - 1. Scope of work shall include building wide air and water balance.

#### **1.3 REFERENCES**

- A. Associated Air Balance Council:
  - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

#### 1.4 SUBMITTALS

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- D. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
  1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be handwritten, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
  2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
  3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
    - a. General Information and Summary
    - b. Air Systems
    - c. Refrigerant Systems
    - d. Temperature Control Systems
    - e. Special Systems.
  4. Report Contents: Provide the following minimum information, forms, and data:



- a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal's name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

## 1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
  1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement, and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
  2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
  1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
  2. AABC: "National Standards for Total System Balance."
  3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of

installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

## **1.6 PROJECT CONDITIONS**

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

## **1.7 SEQUENCING AND SCHEDULING**

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

## **PART 2 - PRODUCTS**

Not Used.

## **PART 3 - EXECUTION**

### **3.1 SERVICES OF THE MECHANICAL CONTRACTOR**

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
  - 1. Systems are started and operating in safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed, and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
  - 12. Hydronic systems are flushed, filled, and vented.

13. Pumps are rotating correctly.
  14. Proper strainer baskets are clean and in place or in normal position.
  15. Service and balancing valves are open.
  16. Re-sheave
- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair, or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

### **3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR**

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
  2. Hydronic systems are filled, clean, and free of air.
  3. Automatic temperature-control systems are operational.
  4. Equipment and duct access doors are securely closed.
  5. Balance, smoke, and fire dampers are open.
  6. Isolating and balancing valves are open and control valves are operational.
  7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  8. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.3 INSTALLATION TOLERANCES**

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
  2. Air Outlets and Inlets: +/- 5%
  3. Heating-Water Flow Rate: +/- 5%
  4. Cooling-Water Flow Rate: +/- 5%

### **3.4 ADJUSTING**

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### **3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

### 3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
  3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Adjust using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS**

- A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
  2. Verify sufficient inlet static pressure before making volume adjustments.
  3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

### 3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 3. Measure total system airflow. Adjust to within indicated airflow.
  - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  - 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  - 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Balance variable-air-volume systems the same as described for constant-volume air systems.

2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.
  4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Adjust terminal units for minimum airflow.
  6. Measure static pressure at the sensor.
  7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.



### **3.9 PROCEDURES FOR MULTIZONE SYSTEMS**

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

### **3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  - 1. Open all manual valves for maximum flow.
  - 2. Check liquid level in expansion tank.
  - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
  - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  - 6. Set system controls so automatic valves are wide open to heat exchangers.
  - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### **3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS**

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

### **3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS**

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### **3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS**

- A. Balance the primary circuit flow first and then balance the secondary circuits.

### **3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS**

- A. The test and balance contractor shall provide testing, adjusting, and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
  - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
  - 2. Verify recirculation pump operation and rotation.
  - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
  - 1. Pressure, temperature, and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
  - 2. Pressure, temperature, and flow in gpm at the suction side of each circulating pump.

### **3.15 PROCEDURES FOR HEAT EXCHANGERS**

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

### **3.16 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove

proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### **3.17 PROCEDURES FOR CHILLERS**

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
  2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
  3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
  4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
  5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
  6. Capacity: Calculate in tons of cooling.
  7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

### **3.18 PROCEDURES FOR COOLING TOWERS**

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

### **3.19 PROCEDURES FOR CONDENSING UNITS**

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### **3.20 PROCEDURES FOR BOILERS**

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

### 3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
  - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 3. Check the refrigerant charge.
  - 4. Check the condition of filters.
  - 5. Check the condition of coils.
  - 6. Check the operation of the drain pan and condensate-drain trap.
  - 7. Check bearings and other lubricated parts for proper lubrication.
  - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
  
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  - 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.
  - 4. Fans are clean.
  - 5. Bearings and other parts are properly lubricated.
  - 6. Deficiencies noted in the preconstruction report are corrected.
  
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
  - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  - 4. Balance each air outlet.

### 3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB contractor.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
  - 15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Filter static-pressure differential in inches wg (Pa).
    - f. Preheat-coil static-pressure differential in inches wg (Pa).
    - g. Cooling-coil static-pressure differential in inches wg (Pa).
    - h. Heating-coil static-pressure differential in inches wg (Pa).
    - i. Outdoor airflow in cfm (L/s).
    - j. Return airflow in cfm (L/s).
    - k. Outdoor-air damper position.
    - l. Return-air damper position.
    - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:

1. Coil Data:
  - a. System identification.
  - b. Location.
  - c. Coil type.
  - d. Number of rows.
  - e. Fin spacing in fins per inch o.c.
  - f. Make and model number.
  - g. Face area in sq. ft
  - h. Tube size in NPS (DN).
  - i. Tube and fin materials.
  - j. Circuiting arrangement.
  
2. Test Data (Indicated and Actual Values):
  - a. Air flow rate in cfm (L/s).
  - b. Average face velocity in fpm (m/s).
  - c. Air pressure drop in inches wg (Pa).
  - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
  - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
  - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
  - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
  - h. Water flow rate in gpm (L/s).
  - i. Water pressure differential in feet of head or psig (kPa).
  - j. Entering-water temperature in deg F (deg C).
  - k. Leaving-water temperature in deg F (deg C).
  - l. Refrigerant expansion valve and refrigerant types.
  - m. Refrigerant suction pressure in psig (kPa).
  - n. Refrigerant suction temperature in deg F (deg C).
  - o. Inlet steam pressure in psig (kPa).
  
- G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
  1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Fuel type in input data.
    - g. Output capacity in Btu/h (kW).
    - h. Ignition type.
    - i. Burner-control types.
    - j. Motor horsepower and rpm.
    - k. Motor volts, phase, and hertz.
    - l. Motor full-load amperage and service factor.
    - m. Sheave make, size in inches, and bore.
    - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  
  2. Test Data (Indicated and Actual Values):



- a. Total air flow rate in cfm (L/s).
  - b. Entering-air temperature in deg F.
  - c. Leaving-air temperature in deg F.
  - d. Air temperature differential in deg F.
  - e. Entering-air static pressure in inches wg (Pa).
  - f. Leaving-air static pressure in inches wg (Pa).
  - g. Air static-pressure differential in inches wg (Pa).
  - h. Low-fire fuel input in Btu/h (kW).
  - i. High-fire fuel input in Btu/h (kW).
  - j. Manifold pressure in psig (kPa).
  - k. High-temperature-limit setting in deg F.
  - l. Operating set point in Btu/h (kW).
  - m. Motor voltage at each connection.
  - n. Motor amperage for each phase.
  - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h (kW).
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Air flow rate in cfm.
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm.
  2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btu/h (kW).
    - b. Air flow rate in cfm.
    - c. Air velocity in fpm.
    - d. Entering-air temperature in deg F.
    - e. Leaving-air temperature in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches, and bore.
    - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg (Pa).
    - e. Duct size in inches.
    - f. Duct area in sq. ft.
    - g. Indicated air flow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual air flow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft.
  2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm.
    - b. Air velocity in fpm.

- c. Preliminary air flow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final air flow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
- 1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm (L/s).
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig (kPa).
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig (kPa).
    - h. Required net positive suction head in feet of head or psig (kPa).
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Static head in feet of head or psig (kPa).
    - b. Pump shutoff pressure in feet of head or psig (kPa).
    - c. Actual impeller size in inches.
    - d. Full-open flow rate in gpm.
    - e. Full-open pressure in feet of head or psig (kPa).

- f. Final discharge pressure in feet of head or psig (kPa).
- g. Final suction pressure in feet of head or psig (kPa).
- h. Final total pressure in feet of head or psig (kPa).
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

N. Vibration Test:

1. Location of points:

- a. Fan bearing, drive end
- b. Fan bearing, opposite end
- c. Motor bearing, center (when applicable)
- d. Motor bearing, drive end
- e. Motor bearing, opposite end
- f. Casing (bottom or top)
- g. Casing (side)
- h. Duct after flexible connection (discharge)
- i. Duct after flexible connection (suction)

2. Test readings:

- a. Horizontal, velocity and displacement
- b. Vertical, velocity and displacement
- c. Axial, velocity, and displacement
- d. Normally acceptable readings, velocity, and acceleration
- e. Unusual conditions at time of test
- f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

**END OF SECTION 23 05 93**

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

#### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.
- B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:
  - 1. NFPA 90A.
  - 2. NFPA 90B.
  - 3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
  - 4. ASTM C1136: 150 degrees F.
  - 5. ASTM C1290.
  - 6. UL 181 for Class I Air Duct.
  - 7. NAIMA AHS-152T.
- C.

#### 1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

- B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.
- C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

#### **1.6 DELIVERY, STORAGE & HANDLING**

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:**

- A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
  - 1. Owens Corning
  - 2. Johns Manville
  - 3. CertainTeed
  - 4. Knauf brand Insulation
- B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:
  - 1. Childers
  - 2. Foster
  - 3. Vimasco
- C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
  - 1. Perma Glass
  - 2. Alpha Glass
  - 3. Childers
  - 4. Chil-Glas
  - 5. Vimasco

- D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of the following:
  - 1. 3M Fire Barrier Duct Wrap
  - 2. Vesuvius Pyroscat Duct Wrap
  - 3. Unifrax Corporation

**2.2 DUCT WRAP**

- A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.
- B. Density: 0.75 pounds per cubic foot.
- C. Installed minimum R value: 8.3.
- D. Nominal Thickness: 3.0 inches.
- E. Installed Thickness: 2-1/4 inches.
- F. Installed Thermal Conductivity (compressed):  $k = 0.27$
- G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.
- H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.
- J. Testing Method 1338: Fungi Resistance Comply with requirements.
- K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.
- L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

**2.3 ACOUSTICAL FLEXIBLE DUCT LINER:**

- A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.
- A. Density: 1.5 pounds per cubic foot.
- B. Installed minimum R value: 6.3.
- C. Thickness: 1-1/2 inches.
- D. Thermal Conductivity  $k$ , (ASTM C518): 0.24
- E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies (Hz)

<b>Freq. (Hz)</b>	<b><u>125</u></b>	<b><u>250</u></b>	<b><u>500</u></b>	<b><u>1K</u></b>	<b><u>2K</u></b>	<b><u>4K</u></b>	<b><u>NRC</u></b>
<b>TL (dB)</b>	0.19	0.55	0.84	1.0	1.0	.98	.85
- F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.

- G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.
- H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.
- J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.
- K. Bacteria Resistance (ASTM G22): Comply with requirements.
- L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

## 2.4 GREASE EXHAUST DUCT

- A. 1-1/2-inch-thick refractory ceramic blanket or calcia, magnesia and silica with aluminum foil, fiberglass-reinforced scrim encapsulation.
- B. Product to be UL Listed as a two (2) hour duct enclosure.
- C. Product shall be tested in accordance with the following:
  - 1. ASTM G 411
  - 2. ASTM C 51
  - 3. ASTM E 84
  - 4. ASTM E 119
  - 5. ASTM E 136
  - 6. ASTM E 814
  - 7. UL 1978 Sections 12 and B.

## 2.5 ACCESSORIES

- A. Pressure-Sensitivity Aluminum Foil Tapes:
  - 1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
  - 2. Size: At least 2-1/2 inches wide.
- B. Heat-Activated Tapes:
  - 1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.
  - 2. Size: At least three (3) inches wide.
- C. Mastic and Glass Fabric System:
  - a. Material Standard: Listed and labeled under UL 181A, Part III.
  - b. Size: At least three (3) inches wide.

## PART 3 - EXECUTION



### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the duct insulation manufacturer.

### 3.2 INSTALLATION

#### A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.
2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.
3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:
  - a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:
    1. From transverse end of liner: three (3) inches.
    2. Across width of duct: 12 inches on center.
    3. From corners of duct: four (4) inches.
    4. Along length of duct: 18 inches on center.
  - b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:
    1. From transverse end of liner: three (3) inches.
    2. Across width of duct: six (6) inches on center.
    3. From corners of duct: four (4) inches.
    4. Along length of duct: 16 inches on center.
4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.
5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.
6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.
7. If the specification requires use of multiple insulation layers, take the following additional steps:
  - a. Affix bottom layer of duct liner in normal manner.
  - b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
  - c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.

- d. Use mechanical fasteners of the proper length for the double layer.
- 8. Application: Provide duct liner as follows:
  - a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
  - b. Provide duct liner in all return air boots and transfer ducts.
  - c. Provide duct liner in the first 15 feet of supply and return duct from roof mounted air handling units / roof top units.
  - d. Provide bull nose “Z” channel to liner’s edge in direction of fan.

**B. THERMAL INSULATION WRAP ON DUCT AND FITTINGS:**

- 1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.
- 2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.
- 3. To ensure installed thermal performance, duct wrap insulation shall be cut to “stretch-out” dimensions as shown in tables in manufacturer’s literature.
- 4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
- 5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.
- 6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.
- 7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.
- 8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.
- 9. Application: Provide duct wrap as follows:
  - a. All supply ducts.
  - b. All outside air supply and intake duct.
  - c. All return air duct.

- d. All return air plenums on air units.
- e. All intake plenums on outside air handling units.
- f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

**C. GREASE EXHAUST DUCT AND FITTINGS:**

1. Provide one (1) or two (2) layers of Ductwrap to create a 2-hour rated duct enclosure. Each layer shall be lapped a minimum of three (3) inches. Inner layer shall be held in place with one (1) inch wide filament tape, spaced 1-1/2 inch from edges and midway at 10-1-2 centers. The outer layer shall be offset by 10-1/2 inches of inner layer, and one (1) inch wide filament tape shall be used in same manner as inner layer. 1/2-inch x 0.015-inch carbon steel banding strips on shall be installed same dimensions as tape to secure both layers on duct. All horizontal and vertical support hangers shall be wrapped with 1-layer of fire rated duct wrap and be secured with stainless steel ties or 1/2-inch hose clamps.
2. Access Door Installation: Four galvanized steel threaded rods, 1/4-inch diameter by 5 inches long are to be welded to the duct at the corners of the door opening. Four steel tubes, each 3 inches long, are placed over the rods to act as protection for the duct wrap when fastening the door. Four insulation pins are to be welded to the door panel for installation of the blanket. One layer of duct wrap is cut approximately the same size as the access panel and impaled over the insulation pins on the panel. It is essential that this layer fit tightly against the wrap surrounding the access door opening with no through openings. A second layer of duct wrap is cut to overlap the first layer by a minimum of one (1) inch. The second layer is impaled over the pins and both layers are locked in place with galvanized speed clips. Pins that extend beyond the outer layer of duct wrap shall be turned down to avoid sharp points. The insulated door panel is placed over the threaded rods and held in place with washers and wing nuts. Provide an access door at each change in duct direction and a minimum of every 10 feet on straight duct.
3. Filament tape can be used to temporarily hold the blanket in place until the banding is applied. The steel banding is applied around the duct 1-1/2 inch from edge of the blanket, and maximum 10-1/2-inch centers. The banding is placed around the material and tightened so as to sufficiently hold the duct wrap in place against the duct, compressing the foil but not cutting the foil.
4. Additional Pinning to Prevent Sagging of Wrap: For ducts 24 inches and larger in width, additional pins are needed to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run. Space pins a maximum of 10-1/2 inches apart in the direction of the blanket width, and a maximum of 12 inches apart in the direction of the blanket length.
5. Provide 12 ga copper-coated steel insulation pins with 1.5-inch square or round cup-head pins. Insulation pins are to be welded to ducts.
6. Duct Support Systems: Provide one layer of insulation to cover support components. Maintain 3-inch overlap.
7. Application:

- a. Provide 2-hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.

**D. INTERIOR EXPOSED DUCT**

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 1-1/2", 1.5 pcf (installed R-Value of 6.0) on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.
2. Round duct to be galvanized spiral lockseam type.
3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.
4. Application: Provide double wall duct as follows:
  - a. Gymnasiums
  - b. Natatoriums
  - c. Return air plenums with ducted connection to return grilles
  - d. Ducted connections to return air grilles
  - e. Any area where ductwork is exposed

**E. INTERIOR EXPOSED DUCT**

5. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 2", 2.0 pcf insulation (installed R-value of 8.0) on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.
6. Round duct to be galvanized spiral lockseam type.
7. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.
8. Application: Provide double wall duct as follows:
  - a. Gymnasiums
  - b. Natatoriums
  - c. Return air plenums with ducted connection to return grilles
  - d. Ducted connections to return air grilles
  - e. Any area where ductwork is exposed

**3.3 FIELD QUALITY CONTROL**

- A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

### **3.4 PROTECTION**

- A. Protect installed work from damage due to subsequent construction activity on the site.

### **3.5 INSULATION SCHEDULE**

- A. Supply and return ducts routed indoors (Ambient temperature  $\leq$  85 degrees Fahrenheit, RH  $\leq$  70 percent): R-8.3 (minimum).
- B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms, and crawl spaces. (Ambient temperature  $\leq$  95 degrees Fahrenheit, RH  $\leq$  70 percent): R-8.3 (minimum).
- C. Supply, return, and exhaust ducts routed in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).
- D. R-values represent installed values.
- E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

**END OF SECTION 23 07 13**

## **SECTION 23 07 16 - HVAC EQUIPMENT INSULATION**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Chilled Water Components
  - 2. Heating Hot Water Components

#### **1.2 SYSTEM DESCRIPTION**

- A. Provide equipment insulation systems that have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide equipment insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
  - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
  - 2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.
- B. Condensation on any insulated system is not acceptable. Replace insulation damaged by condensation.
- C. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

- D. Certifications: Manufacturer certification that products supplied meet or exceed specified requirements.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Glass Fiber Insulation: Subject to compliance with plans and specification, provide one of the following:
  - 1. Johns Manville
  - 2. Owens-Corning
  - 3. Knauf
  - 4. Certainteed
  - 5. Pittsburgh-Corning
  - 6. Schuller
  - 7. Armstrong
  - 8. Benjamin-Foster
  - 9. Childers
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
  - 1. Pittsburg Corning
  - 2. Cell-U-Form
- C. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
  - 1. Perma Glass Mesh
  - 2. Alpha Glass Mesh
  - 3. Childers Chil-Glas
  - 4. Vimasco
  - 5. RPR Products Inc.

- D. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
1. Childers
  2. Foster
  3. Vimasco

## 2.2 EQUIPMENT INSULATION

- A. Glass Fiber Insulation Boards:
1. Thickness: Same thickness as connected piping.
  2. Equipment Operating Temperature Limit (ASTM C411): Up to 450 degrees Fahrenheit.
  3. Insulation Jacket Temperature Limit (ASTM C1136): -20 - 150 degrees Fahrenheit.
  4. Vapor Retarder: ASJ vapor retarder facing.
  5. Jacket Permeance (ASTM E96): 0.02 perm.
  6. Jacket Puncture Resistance (ASTM D781): ASJ: 50 units.
  7. Water Vapor Sorption (ASTM C1104): <2percent by weight at 120 degrees Fahrenheit.
  8. Density: Same as adjoining pipe insulation.
  9. Composition Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25, smoke developed 50.
- B. Equipment and Tank Insulation:
1. Description: Flexible pipe and tank insulation made of semi-rigid fibrous glass board material with a laminated Kraft-aluminum foil ASJ facing.
  2. Operating Temperature (ASTM C411): 0 - 650 degrees Fahrenheit.
  3. Length: 36 inches.
  4. Size: 1-1/2 inches.
  5. Material Standard: Comply with ASTM C1393, Type II.
  6. Material Standard: Comply with ASTM C795.
  7. Material Standard: Comply with ASTM C1136, Type II.
  8. Material Standard: Comply with NRC Guide 1.36.
  9. Jacket Temperature Limitation (ASTM C1136): -20 - 50 degrees Fahrenheit.
  10. Jacket Permeance (ASTM E961): 0.02 perm.



11. Puncture Resistance (ASTM D781): 50 units.
12. Compressive Strength at 10 % Deformation (ASTM C165): 125 psf.

### **2.3 CELLULAR GLASS INSULATION**

- A. Rigid factory fabricated closed-cell equipment insulation:
  1. Thermal conductivity "k" of btuh-in / hr-sq.ft. degree F at 75-degree mean temperature.
  2. Density shall be an average of 8 lb./cu.ft.
  3. Compressive strength of 100 psi.

### **2.4 ALUMINUM JACKET**

- A. Jacket for equipment and tanks shall be 0.16-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering. Fitting covers shall be manufactured to ASTM C-450 standards.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breeching, or stacks while hot.
- E. Apply insulation using staggered joint method for both single- and double-layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least two (2) inches. Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- A. Comply with the instructions and recommendations of the equipment insulation manufacturer.

### **3.3 EXAMINATION**

- A. Site Verification of Conditions:
- B. Verify that site conditions are acceptable for installation of equipment insulation.
- C. Do not proceed with installation of equipment insulation until unacceptable conditions are corrected.

### **3.4 INDOOR CHILLED WATER PUMPS**

- A. Shall be insulated with Certain-Teed IB-600 rigid insulation board, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide x .020 galvanized bands spaced on nine (9) inch centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of Foster's 30-50 vapor barrier mastic, a layer of one (1) inch mesh galvanized wire, and a coat of J.M. #352 cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place with Foster's 30-60 Sealfas.
- B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

### **3.5 OUTDOOR CHILLED WATER PUMPS**

- A. Shall be insulated with cellular glass insulation, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide aluminum bands spaced on nine (9) inch centers. Bands shall be pulled snug over insulation. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. Provide aluminum jacket over insulation.

### **3.6 ALUMINUM JACKET**

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping, sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.

- E. Lap joints against weather so that water will run off lower edge.
- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.
- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. Equipment exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

### **3.7 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATED WITH FIBERGLASS**

- A. Location: Indoor, conditioned spaces
- B. Support Inserts: At each support point, install a hard section of cellular glass on lower 180 degrees of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Seal and finish to match the adjoining insulation. Provide formed 16 ga. galvanized sheet-metal saddles.
- C. Installation: All equipment must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide three (3) inch butt strips at each joint between sections and seal with adhesive.

### **3.8 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATE WITH CELLULAR GLASS**

- A. Location: Outdoor, un-conditioned spaces and ventilated spaces
- B. The insulation shall be applied to equipment with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
- C. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
- D. Metal jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
- E. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

### **3.9 INSULATION SCHEDULE**

- A. Chilled water components located within condition spaces.
  - 1. Insulation thickness: Match adjoining piping thickness.

- B. Chilled water components located in un-conditioned or ventilated spaces and outdoors
  - 1. Insulation thickness: Match adjoining piping thickness.

**3.10 PROTECTION AND REPLACEMENT**

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

**END OF SECTION 23 07 16**

## SECTION 23 07 19 - HVAC PIPING INSULATION

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes: Pipe Insulation

#### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
  - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.

#### 1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
  - 1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
    - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
    - b. Detail attachment and covering of heat tracing inside insulation.
    - c. Detail insulation application at pipe expansion joints for each type of insulation.
    - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
    - e. Detail removable insulation at piping specialties.
    - f. Detail application of field-applied jackets.
    - g. Detail application at linkages of control devices.

## 1.5 QUALITY ASSURANCE

- A. Installation Qualifications: Utilize an installer having demonstrated (5) five years experience on projects of similar size and complexity.
- B. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.
- C. All materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84):
  - 1. Flamespread: 25
  - 2. Smoke developed: 50
- D. All materials shall have U.L. label.

## 1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver insulation materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
  - 1. Johns Manville
  - 2. Owens Corning
  - 3. Knauf

4. Certainteed
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
  1. Pittsburg Corning
  2. Cell-U-Foam
- C. Phenolic Foam Insulation: Subject to compliance with plans and specification, provide one of the following:
  1. Resolco
  2. Koolphen® K
- D. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
  1. Childers
  2. Pabco
  3. RPR
- E. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
  1. Perma Glass Mesh
  2. Alpha Glass Mesh
  3. Childers Chil-Glas
  4. Vimasco
- F. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
  1. Childers
  2. Foster
  3. Vimasco

## **2.2 FIBERGLASS PIPE INSULATION**

- A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
  1. Thermal conductivity “k” of 0.23 of Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
  2. Maximum jacket permeance shall be 0.02.

## **2.3 CELLULAR GLASS INSULATION**

- A. Rigid factory fabricated closed-cell pipe insulation:
  1. Thermal conductivity “k” of 0.32 Btuh-in / hr-sq.ft. °F at 75-degree mean temperature.
  2. Density shall be an average of 8 lb/cu.ft.
  3. Maximum jacket permeance shall be 0.02.
  4. Compressive strength of 100 psi.

## **2.4 PHENOLIC FOAM INSULATION**

- A. Rigid factory molded phenolic foam insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
  - 1. Thermal conductivity "k" of 0.15 btu-in / hr-sq.ft. °F at 75°-degree mean temperature.
  - 2. Maximum jacket permeance shall be 0.02.
  - 3. Compressive strength of 100 psi

## **2.5 ALUMINUM JACKET**

- A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

## **PART 3 -EXECUTION**

### **3.1 SITE INSPECTION**

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer's recommendations.

### **3.2 PREPARATION**

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

### **3.3 INSTALLATION**

- A. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- B. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.



- D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- F. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- G. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- H. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- I. Apply multiple layers of insulation with longitudinal and end seams staggered.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- L. Keep insulation materials dry during application and finishing.
- M. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- N. Apply insulation with the least number of joints practical.
- O. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder is indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

- U. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- V. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- W. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder
  - 4. Vapor-Retarder Mastics: Where vapor retarder is indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings, at penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
  - 5. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
    - b. Seal penetrations with vapor-retarder mastic
    - c. Apply insulation for exterior applications tightly joined to interior insulation ends.
    - d. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
    - e. Seal metal jacket to roof flashing with vapor-retarder mastic.
  - 6. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
  - 7. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
  - 8. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
    - a. Fire stopping and fire-resistive joint sealers are specified in Division 7.
  - 9. Floor Penetrations: Apply insulation continuously through floor assembly.
    - a. For insulation with vapor retarder, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

- X. Insulation Installation of Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
  3. For insulation with factory-applied jackets without integral vapor retarder, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- Y. Insulation Installation on Pipe Flanges:
1. Apply preformed cellular-glass pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cellular-glass block insulation.
  4. Install jacket material with manufacturers recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- Z. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of molded cellular-glass insulation and match thickness to that of adjoining pipe. Fittings and fabricated segments shall be securely held in place with ½ inch x 0.20-inch type 3105 aluminum bands.
    - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
    - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
    - c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.
- AA. Insulation Installation on Valves:
1. Install preformed two-piece factory molded cellular-glass insulation to valve body, match adjoining pipe insulation thickness. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application.
    - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
    - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

- c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

BB. PVC Cover:

- 1. Provide factory molded covers for all fittings, elbows, and flanges.

### 3.4 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
  - a. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - b. Embed 10 x 10 fiberglass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
  - c. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Apply foil and paper jackets where indicated.
  - a. Draw jacket material smooth and tight.
  - b. Apply lap or joint strips with the same material as jacket.
  - c. Secure jacket to insulation with manufacturer's recommended adhesive.
  - d. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints. Where vapor retarder is indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder mastic to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
  - e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

### 3.5 CHILLED WATER, HOT WATER, CONDENSATE DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Indoor, conditioned spaces - return air plenums, air handling unit rooms
- B. Insulation Type:
  - 1. Heating Water and Condensate Piping: **Fiberglass**
  - 2. Chilled Water Piping: **Phenolic Foam**
- C. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation. Cellular glass length shall overhang a minimum of 2" on both sides of the saddle. Refer to 3.5, E for saddle length requirements.
- D. Provide formed 16 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside

hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, 3/4" width and joined with 3/4" aluminum wing seals.

- E. Provide formed 16 ga. galvanized sheet-metal saddles as follows:
  - 3. Insert and saddle lengths:
    - a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
    - b. 3 inch through 6-inch pipe - 12 inches Long
    - c. 8 inch through 10-inch pipe - 16 inch Long
    - d. 12 inches and larger pipe - 22 inches Long
- F. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide 3-inch butt strips at each joint between sections and seal with adhesive.
- G. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

### 3.6 CHILLED WATER, HOT WATER, CONDENSATION DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Outdoor, un-conditioned spaces (non-return air plenums) and ventilated spaces. Shall include but not limited to boiler rooms, non-return air plenum mechanical rooms, chiller rooms, and pump rooms.
- B. Insulation Type:
  - 1. Condensate Piping: **Fiberglass**
  - 2. Chilled Water and Heating Water Piping: **Phenolic Foam**
- C. Cellular Glass Installation:
  - 1. The insulation shall be applied to piping with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
  - 2. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
  - 3. Aluminum jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
  - 4. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.
- D. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation.
- E. Provide formed 14 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends

with aluminum banding with a thickness of 0.20, 3/4" width and joined with 3/4" aluminum wing seals.

- F. Provide formed 14 ga. galvanized sheet-metal saddles as follows:
  - 1. Insert and saddle lengths:
    - a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
    - b. 3 inch through 6-inch pipe - 12 inches Long
    - c. 8 inch through 10-inch pipe - 16 inch Long
    - d. 12 inches and larger pipe - 22 inches Long
- G. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive and vapor retarder mastic. Provide 3-inch butt strips at each joint between sections and seal with adhesive.
- H. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

### 3.7 ALUMINUM JACKET

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping and sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.
- E. Lap joints against weather so that water will run off lower edge.
- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.
- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. Pipe exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.
- K. All exterior pipes shall have specified aluminum jacket for protection.

### 3.8 PROTECTION

- A. Replace damaged aluminum jacketing and insulation, including insulation with vapor barrier damage and moisture-saturated insulation.

- B. The insulation contractor shall advise the general and / or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

### 3.9 INSULATION SCHEDULE

- A. Chilled water piping located within condition spaces.
  - 1. Insulation thickness (**Phenolic Foam**):
    - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
    - b. 2" thick insulation for: 2-1/2" and larger pipe
- B. Chilled water and hot water piping located in central plant, un-conditioned or un-ventilated spaces and outdoors.
  - 1. Insulation thickness (**Phenolic Foam**):
    - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
    - b. 2" thick insulation for: 2-1/2" and larger pipe
- C. Hot water piping located within conditioned spaces
  - 1. Insulation thickness: (**Fiberglass**):
    - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
    - b. 2" thick insulation for: 2-1/2" and larger pipe
- D. Cold Condensate Drain Lines
  - 1. Insulation thickness: (**Fiberglass**):
    - a. 1-1/2" thick insulation for all pipe sizes and locations

**END OF SECTION 23 07 19**

## **23 08 00 – HVAC SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS**

### **PART 1 – GENERAL**

#### **1.1. RELATED DOCUMENTS**

- 1.1.1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.1.2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

#### **1.2. SUMMARY**

- 1.2.1. The purpose of this Section is to define responsibilities in the Commissioning Process. Additional system testing is required within individual Specification Sections.
- 1.2.2. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 20-25 Contractors shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Owner's CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- 1.2.3. HVAC systems to be commissioned include the following:
  - 1.2.3.1. Chillers
  - 1.2.3.2. Boilers
  - 1.2.3.3. Pumps
  - 1.2.3.4. Air Handling Unit Systems
  - 1.2.3.5. DX Split Systems
  - 1.2.3.6. Air Terminal Units (10% Sampling)
  - 1.2.3.7. Fan Coil Units
  - 1.2.3.8. Exhaust and Supply Fan Systems
  - 1.2.3.9. Fire, Fire/Smoke and Volume Dampers (Review of testing documentation provided by the contractor)
  - 1.2.3.10. HVAC / Building Automation System and Integrations
  - 1.2.3.11. HVAC / Emergency Power Source Integrations
  - 1.2.3.12. HVAC / Life Safety Systems Integrations
- 1.2.4. The TAB Contractor will perform control sequence verification on each terminal unit shall independently verify each sensor and point and document the results to be included in the Final TAB Report. The CxA will commission 10% of the terminal units once TAB is complete with the CSV and point verification of the terminal units.

#### **1.3. DEFINITIONS**

- 1.3.1. Refer to the General Commissioning Requirements for definitions.

#### **1.4. SUBMITTALS**

- 1.4.1. Contractor shall provide Owner and/or CxA with documentation required for Commissioning Work. At minimum, documentation shall include Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.



- 1.4.1.1. Shop drawings and product submittal data related to systems or equipment to be commissioned.
- 1.4.2. Contractor shall submit to Owner and/or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- 1.4.3. Where installation testing may be performed in a progressive manner (i.e., piping hydrostatic testing, ductwork pressure testing, etc.), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be performed, documented, and presented for approval prior to the start of any testing activities.
- 1.4.4. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process
  - 1.4.4.1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
  - 1.4.4.2. Installation testing reports such as ductwork pressure testing, piping hydrostatic testing, piping chemical treatment, and flushing, bolt flange torqueing, and any documentation associated with local code authority inspections or authorizations.
  - 1.4.4.3. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
  - 1.4.4.4. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements.

## **PART 2 - PRODUCTS**

### **2.1. GENERAL**

- 2.1.1. All materials and installation shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- 2.1.2. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- 2.1.3. Contractor is required to follow all applicable industry and site-specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

### **2.2. TEST EQUIPMENT**

- 2.2.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- 2.2.2. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments

according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

### **PART 3- EXECUTION**

#### **3.1. CONSTRUCTION PHASE**

- 3.1.1. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- 3.1.2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.
- 3.1.3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- 3.1.4. Provide additional requested documentation to the Owner and/or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
  - 3.1.4.1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
  - 3.1.4.2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and/or CxA.
  - 3.1.4.3. This information and data request may be made prior to normal submittals.
- 3.1.5. With input from the BAS vendor and A/E, clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
- 3.1.6. During the installation, Start-up, and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- 3.1.7. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
- 3.1.8. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.

- 3.1.9. Incorporate manufacturer's Start-up procedures with System Verification Checklists (SVC).
  - 3.1.10. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.
  - 3.1.11. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
  - 3.1.12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
  - 3.1.13. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).
  - 3.1.14. Provide training of the Owner's operating personnel as specified.
  - 3.1.15. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- 3.2. WARRANTY PHASE
- 3.2.1. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.
    - 3.2.1.1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.
  - 3.2.2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.
- 3.3. INSTALLATION
- 3.3.1. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards, and conform to codes and ordinances of authorities having jurisdiction.
  - 3.3.2. All installation shall be in accordance with the Project Documents.
- 3.4. TRAINING
- 3.4.1. Refer to the individual section of this Specification for specific training requirements on each system.
  - 3.4.2. Refer to the General Commissioning Requirements and Division 01 for overall training requirements related to the Commissioning process and this project.

## **SECTION 23 21 13 - HYDRONIC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
  - 1. Hot water heating piping.
  - 2. Chilled water piping.
  - 3. Condenser water piping.
  - 4. Make-up water piping.
  - 5. Condensate-drain piping.
  - 6. Blowdown drain piping.
  - 7. Air-vent piping.
- B. Related Sections include the following:
  - 1. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for Hydronic piping.

#### **1.3 DEFINITIONS**

- A. PTFE: Polytetrafluoroethylene.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

#### **1.5 SYSTEM DESCRIPTION**

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

#### **1.6 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
  2. RTRP and RTRF with adhesive.
  3. Pressure-seal fittings.
- C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. The Pipe shop drawings shall be superimposed on the architectural backgrounds.

#### **1.7 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Field quality-control test reports.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

#### **1.8 QUALITY ASSURANCE**

- A. All pipe and accessories shall be of United States domestic manufacture.
- B. Installer Qualifications:
  1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.

- G. Maintain one copy of each document on site.
- H. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Piping shall not be set on ground; utilize wood blocking and keep a minimum of 6" above ground.
- D. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- E. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- F. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

### **1.10 WELDING**

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

## **PART 2 - PRODUCTS**

### **2.1 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

- B. Wrought-Copper Fittings: ASME B16.22.
  - 1. Housing: Ductile Iron.
  - 2. Gasket: EPDM, Grade EHP
  - 3. Pipe Sizes 2" and larger
  - 4. Tools: Manufacturer's grooving tools.
  - 5. Minimum 300-psig working-pressure rating at 250 deg F.
  
- C. Copper or Bronze Pressure-Seal Fittings:
  - 1. Housing: Copper.
  - 2. O-Rings and Pipe Stops: EPDM.
  - 3. Pipe Sizes 2" and down
  - 4. Tools: Manufacturer's special tools.
  - 5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F.
  
- D. Wrought-Copper Unions: ASME B16.22.

## **2.2 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends; application as indicated in Part 3 "Piping Applications" Article.
  
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
  
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
  
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
  
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 250.
  
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
  
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.
  - 3. Facings: Raised face.
  
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

## **2.3 PLASTIC PIPE AND FITTINGS**

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
  
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings; ASTM F 439 for Schedule 80 pipe.
  
- C. PVC Plastic Pipe: ASTM D 1785, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
  
- D. PVC Plastic Pipe Fittings: Socket-type pipe fitting; ASTM D 2467 for Schedule 80 pipe.

## 2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. CPVC Piping: ASTM F 493.
    - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.



## 2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX Inc.
    - c. KBi.
  - 2. CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.
- B. Plastic-to-Metal Transition Unions:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. IPEX Inc.
    - c. KBi.
    - d. NIBCO INC.
  - 2. MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Hart Industries International, Inc.
    - d. Jomar International Ltd.
    - e. Matco-Norca, Inc.
    - f. McDonald, A. Y. Mfg. Co.
    - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - h. Wilkins; a Zurn company.
  - 2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 150 psig minimum at 180 deg F.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Matco-Norca, Inc.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - e. Wilkins; a Zurn company.
  
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 150 psig minimum at 180 deg F.
    - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  
  2. Description:
    - a. Non-conducting materials for field assembly of companion flanges.
    - b. Pressure Rating: 150 psig.
    - c. Gasket: Neoprene or Phenolic.
    - d. Bolt Sleeves: Phenolic or polyethylene.
    - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection.
    - b. Matco-Norca, Inc.
    - c. Precision Plumbing Products, Inc.
    - d. Victaulic Company.
  
  2. Description:
    - a. Standard: IAPMO PS 66
    - b. Electroplated steel nipple. Complying with ASTM F 1545.
    - c. Pressure Rating: 300 psig 225 deg F.
    - d. End Connections: Male threaded or grooved.
    - e. Lining: Inert and noncorrosive, propylene.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS**

- A. Hot water heating and chilled water above ground, NPS 2 and smaller, shall be the following:
  - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot water heating and chilled water above ground, NPS 2-1/2 and larger, shall be the following:
  - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Condenser water above ground shall be the following:
  - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. Condenser piping located outdoors in mechanical yard shall be galvanized.
- D. Makeup-water piping installed aboveground shall be the following:
  - 1. ASTM B 88, Type K (ASTM B 88M, Type B) drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- E. Condensate-Drain Piping (**Air Handling Units**):
  - 1. Schedule 40 galvanized steel pipe with threaded joints.
- F. Condensate-Drain Piping (**Fan Coil Units**): ASTM B 88, Type L (ASTM B 88M, Type B) hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- G. Condensate-Drain Piping (**Condensing Boilers**):
  - 1. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- H. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow-down drain is installed.
- I. Air-Vent Piping:
  - 1. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

#### **3.2 PIPING INSTALLATIONS**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
  - 1. Maximum hanger rod spacing shall not exceed 8'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."
- U. Install lateral bracing with pipe hangers and supports to prevent swaying.
- V. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- X. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment".
- Y. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 – "Hangers and Supports for HVAC Piping and Equipment".
- Z. Provide access doors where valves and fittings are not accessible.
- AA. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- BB. Provide unions or flanges and isolation valves at each connection to a piece of equipment or control valve; accessory which requires removal for maintenance. Screwed unions should be used for two (2) inches IPS and smaller. Locate joints where they can be accessed for repair. Screw or flanged joints shall not be permitted above inaccessible ceilings or in chases.
- CC. All piping shall be installed to eliminate traps and pockets. Where air pockets or water trap cannot be avoided, provide means for drainage with valved hose connections for water trap and air vents for air pockets. Provide drain valves at low points of the system.
- DD. For pipe inside building, install parallel to lines of building, close to columns and walls vertical pipe shall be truly vertical. Spring or forcing piping into place will not be permitted. Install pipe to prevent strain on equipment connections.
- EE. Provide adequate access to all equipment, motorized valves, instruments, controls and access panels.
- FF. Allow easy draining of water piping, with drain valves at low points.

### **3.3 PIPE JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- M. Branch Connections: Weld-O-Let or Thread-O-Let is not acceptable.
- N. No Victaulic fittings in the interior of the building.

### **3.4 TERMINAL EQUIPMENT CONNECTIONS**

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

### **3.5 FIELD QUALITY CONTROL**

- A. Prepare Hydronic piping according to ASME B31.9 and as follows:
  1. Leave joints, including welds, un-insulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  3. Flush Hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on Hydronic piping **(to be witnessed by Owner and Consultant)**:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  3. Isolate expansion tanks and determine that Hydronic system is full of water.
  4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  5. After hydrostatic test pressure has been applied for at least one hour, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
  6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
  2. Inspect pumps for proper rotation.
  3. Set makeup pressure-reducing valves for required system pressure.
  4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  5. Set temperature controls so all coils are calling for full flow.
  6. Inspect and set operating temperatures of Hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  7. Verify lubrication of motors and bearings.

**END OF SECTION 23 21 13**



## **SECTION 23 21 23 - HYDRONIC PUMPS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. In-line circulators
  - 2. Split-Coupled Vertical In-line pumps
  - 3. Pump Suction Diffusers
- B. Related Sections:
  - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment - Mechanical Vibration Control: Product requirements for vibration isolators required with pumps.

#### **1.3 REFERENCES**

- A. Underwriters Laboratories Inc.:
  - 1. UL 778 - Motor Operated Water Pumps.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Provide pumps electrical characteristics in accordance with Division 26 and schedules on Drawings.

#### **1.5 SUBMITTALS**

- A. Submit in accordance with Division 1 and Section 23 05 00.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Provide parallel pump curves indicating the non-overloaded motor horsepower for single pump operation when applicable. Include NPSH curve with operating point plotted when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- D. Shop Drawings: For each pump.
  - 1. Show pump layout and connections.
  - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 3. Include diagrams for power, signal, and control wiring.

- E. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

**1.6 CLOSEOUT SUBMITTALS**

- A. Submit in accordance with Division 1, General Requirements.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

**1.7 WARRANTY**

- A. Furnish one (1) year manufacturer parts and labor warranty for pumps. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

**1.8 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

**1.9 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
  - 1. Furnish one (1) set of mechanical seals for each pump installed for owner use only.

**1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Pumps shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## **PART 2 - PRODUCTS**

### **2.1 IN-LINE CIRCULATORS**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Armstrong
  - 2. Aurora / Pentair
  - 3. Bell and Gossett
  - 4. Patterson
  - 5. Grundfos
  - 6. Taco
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed to shaft.
- E. Bearings: Two, oil lubricated bronze sleeves.
- F. Shaft: Stainless steel with copper or bronze sleeve, integral thrust collar.
- G. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Flexible coupling.
- I. Motor: Single speed and rigidly mounted to pump casing.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 3. All motors 10 H.P. and larger shall be provided and installed with split bolt Kearney connectors. Wire nuts are not acceptable. An insulated Plastisol multi-tap connector with 2 ports is acceptable.

### **2.2 SPLIT-COUPLED VERTICAL IN-LINE PUMPS**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Armstrong - 4300
  2. Bell and Gossett
  3. Aurora / Pentair
  4. Grundfos
  5. Taco
  6. Patterson
- B. Type: Vertical shaft, single stage, direct connected, radial split casing, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connections with factory installed seal flush line, recessed cast iron drain pan with threaded connection for field piping to drain, flanged suction and discharge. For piping less than two inches, provide unions.
- D. Impeller: Bronze, fully enclosed, dynamically balanced, and keyed to shaft.
- E. Bearings: Greaseable bearings, lubricated roller or ball bearings. Bearings shall have 200,000-hour minimum life.
- F. Shaft: 416 stainless steel with stainless steel shaft sleeve.
- G. Mechanical Seals: Stainless steel multi-spring outside balanced type with a Viton secondary seal, carbon rotating face and Silicon Carbide stationary seat. Provide 316 stainless steel gland plate with factory installed flush line with manual vent, 225 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Axially split, spacer type rigid coupling constructed of high tensile aluminum bar with OSHA approved coupling guard.
- I. Motor: Single speed and rigidly mounted to pump casing.
1. Motors: All motors shall be premium efficiency, NEMA MG-1 Section 3, Inverter Duty, Totally Enclosed Fan Cooled (TEFC).
  2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  4. Pump motors with variable frequency drives shall be provided with factory installed shaft grounding rings.
  5. All motors 10 horsepower and larger shall be provided and installed with split bolt Kearney connectors. Wire nuts are not acceptable. An insulated Plastisol multi-tap connector with 2 ports is acceptable.
  6. Shall be selected to operate at 1,750 RPM.

### 2.3 PUMP SUCTION DIFFUSERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Armstrong
  2. Bell and Gossett
  3. Aurora
  4. Grundfos
  5. Taco
  6. Patterson
  7. American Wheatley
- B. Angle pattern, with flanged outlet and inlet connections; grooved connections shall not be acceptable.
- C. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.
- D. Removable stainless-steel fine mesh startup and 1/8" perforated stainless-steel star shaped permanent strainers.
- E. Stainless-steel straightening guide vanes.
- F. Drain plug, blow-down tapping in bottom, gage tapping on side.
- G. Factory-fabricated adjustable foot support.
- H. Permanent magnet located in flow stream removable for cleaning.

#### **2.4 PUMP IDENTIFICATION REQUIREMENTS**

- A. Provide each pump with a factory fabricated and installed nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins. For chilled water pumps that require insulation; provide an additional factory name plate for external mounting on pump insulation board. Additional name plate shall be of same construction and materials and shall be mounted by installing mechanical contractor. Provide the following information:
- Unit identification as indicated within Contract Documents.
  - Manufacturer, address, telephone number.
  - Serial Number.
  - Model Number.
  - Size (including impeller diameter scheduled in inches).
  - Pump type.
  - Flow scheduled ( gallons per minute).
  - Dynamic head scheduled ( feet of water).
  - Efficiency (percent).
  - Shut-off head (feet of water).
  - Speed (RPM).
  - Brake horsepower.
  - Maximum brake horsepower with rated impeller.
  - Rotation.
  - Maximum allowable pressure (psig).
  - Minimum NPSHR (feet).
  - Electrical characteristics.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide 24" or as required by the manufacturer, whichever is greater.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping
- D. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
  - 1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
  - 2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- E. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals. Route to floor drain.
- H. Lubricate pumps before start-up according to manufacturer's instructions.

#### **3.3 ALIGNMENT – REQUIRED FOR ALL PUMPS PRIOR TO STARTUP**

- A. Alignment Service shall be performed by a factory authorized direct service technician. Alignment work shall not be performed by installing mechanical contractor or "by others".

- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### 3.4 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Discharge side of pumps install flexible connector (for end-suction pumps), non-slam check valve, combination shut-off butterfly valve and throttling valve with memory stop, and thermometer.
- F. Suction side of pumps install suction diffuser with type 304 stainless steel strainer, flexible pipe connector (for end-suction pumps) shut-off butterfly valve on suction side of pumps and thermometer.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

### 3.5 STARTUP SERVICE

- A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
    - a. Check piping connections for tightness.
    - b. Clean strainers on suction piping.
    - c. Perform the following startup checks for each pump before starting:
      - 1. Verify bearing lubrication.
      - 2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

3. Verify that pump is rotating in the correct direction.
  - d. Prime pump by opening suction valves and closing drains and prepare pump for operation.
  - e. Start motor.
  - f. Open discharge valve slowly.

**3.6 DEMONSTRATION**

- A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.
  1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
  2. Provide documentation of owner training in close out submittal.

**END OF SECTION 23 21 23**



## **SECTION 23 23 00 - REFRIGERANT PIPING**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:

1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Refrigerant moisture and liquid indicators.
4. Valves.
5. Refrigerant strainers.
6. Refrigerant pressure regulators.
7. Refrigerant pressure relief valves.
8. Refrigerant filter-driers.
9. Refrigerant solenoid valves.
10. Refrigerant expansion valves.
11. Electronic expansion valves.
12. Refrigerant receivers.

- B. Related Sections:

1. Section 31 00 00 - Earthwork: Earthwork for backfill in trenches.
2. Section 31 23 16.13 – Trenching and Backfilling: Execution requirements for trenching and backfilling required by this section.
3. Section 07 84 00 - Firestopping: and Fire Safing Product requirements for firestopping for placement by this section.
4. Section 08 31 13 - Access Doors: Access doors for concealed valves and accessories.
5. Section 09 91 00 - Painting and Staining: Product requirements for painting for placement by this section.
6. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and sleeves for placement by this section.

7. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
8. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
9. Section 23 07 19 - HVAC Piping Insulation: Product requirements for Piping Insulation for placement by this section.
10. Section 23 21 13 - Hydronic Piping: Piping materials for refrigerant systems.

### 1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
  1. ARI 495 - Refrigerant Liquid Receivers.
  2. ARI 710 - Liquid-Line Driers.
  3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
  4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
  5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. American Society of Mechanical Engineers:
  1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
  3. ASME B31.5 - Refrigeration Piping.
  4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. ASTM International (ASTM):
  1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
  4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

5. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
  2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
  2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
  3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
1. UL 429 - Electrically Operated Valves.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-407C:
1. Suction Lines for Air-Conditioning Applications: 230 psig.
  2. Suction Lines for Heat-Pump Applications: 380 psig.
  3. Hot-Gas and Liquid Lines: 380 psig.
- B. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
  2. Suction Lines for Heat-Pump Applications: 535 psig.
  3. Hot-Gas and Liquid Lines: 535 psig.

#### **1.5 SYSTEM DESCRIPTION**

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Provide receivers sized to accommodate pump down charge.
- E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

## 1.6 SUBMITTALS

- A. Submit in Accordance with Division 1 - General Requirements.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- C. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- D. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories.
  - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
  - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
  - 4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
    - a. Refrigerant moisture and liquid indicators.
    - b. Refrigerant strainers.
    - c. Refrigerant pressure regulators.
    - d. Refrigerant pressure relief valves.
    - e. Refrigerant filter-driers.
    - f. Refrigerant solenoid valves.
    - g. Refrigerant expansion valves.
    - h. Electronic expansion valves.
- E. Test Reports: Indicate results of piping system pressure test.
- F. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- G. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- H. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

### **1.7 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.
- B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

### **1.8 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

### **1.9 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.

### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. In accordance with Division 1- General Requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- F. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- G. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

**1.11 WARRANTY**

- A. Furnish five (5) year manufacturer warranty for valves excluding packing.

**1.12 MAINTENANCE MATERIALS**

- A. Furnish two (2) refrigerant oil test kits each containing everything required for conducting one test.

**1.13 EXTRA MATERIALS**

- A. Furnish two (2) packing kits for each size and valve type.
- B. Furnish two (2) refrigerant filter-dryer cartridges of each type.

**PART 2 - PRODUCTS**

**2.1 REFRIGERANT PIPING**

- A. Copper Tubing: ASTM B 280, Nitrogenized Type L - ACR hard drawn.
  - 1. Wrought-copper Fittings: ASME B16.22.
  - 2. Brazing Filler Metals: AWS A5.8. BCuP: minimum 15% silver (Ag), 5% phosphorous (P), and balance copper (Cu).
  - 3. Final product composition shall be 99% pure copper and lead free.
  - 4. Provide in 10 ft. and 20 ft. straight tube lengths.
  - 5. **Bendable pipe of any kind shall not be accepted.**

**2.2 UNIONS AND FLANGES**

- A. Two (2) inches and Smaller:
  - 1. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches and Larger:
  - 1. Copper Piping: Bronze
  - 2. Gaskets: 1/16-inch-thick preformed neoprene.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

**2.3 REFRIGERANT MOISTURE AND LIQUID INDICATORS**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Alco Controls Div, Emerson Electric Co.
  - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Indicators:

1. Port: Single, UL listed.
2. Body: Brass, solder ends.
3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 200 degrees Fahrenheit.

## 2.4 VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
3. Sporlan Valve Co.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
2. Phosphor bronze and stainless-steel diaphragms, rising stem and hand wheel.
3. Stainless steel spring, nylon seats, disc with positive back seating.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 275 degrees Fahrenheit.

C. Packed Angle Valves:

1. Forged brass, solder ends.
2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig
4. Maximum working temperature: 275 degrees Fahrenheit.

D. Ball Valves:

1. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
2. Maximum working pressure: 500 psig and

3. Maximum working temperature: 300 degrees Fahrenheit.
- E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, solder ends.
  2. Maximum working pressure: 500 psig.
- F. Refrigerant Check Valves:
1. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
    - a. Alco Controls Div, Emerson Electric Co.
    - b. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
    - c. Sporlan Valve Co.
  2. Globe Type:
    - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless-steel spring, Teflon seat disc.
    - b. Maximum working pressure: 500 psig.
    - c. Maximum working temperature: 300 degrees Fahrenheit.
  3. Straight Through Type:
    - a. Spring, neoprene seat.
    - b. Maximum working pressure: 500 psig.
    - c. Maximum working temperature: 250 degrees Fahrenheit.

## 2.5 REFRIGERANT STRAINERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Alco Controls Div, Emerson Electric Co.
  2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
  3. Sporlan Valve Co. Model.
- B. Straight Line or Angle Line Type:
1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless-steel wire or monel reinforced with brass.
  2. Maximum working pressure: 430 psig.



## **2.6 REFRIGERANT PRESSURE REGULATORS**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Alco Controls Div, Emerson Electric Co.
  - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
  - 3. Sporlan Valve Co.
- B. Brass body, stainless steel diaphragm, pilot operated with remote pressure pilot, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

## **2.7 REFRIGERANT PRESSURE RELIEF VALVES**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Alco Controls Div, Emerson Electric Co.
  - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division.
  - 3. Sporlan Valve Co.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; setting selected to ASHRAE 15.

## **2.8 REFRIGERANT FILTER-DRIERS**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Alco Controls Div, Emerson Electric Co.
  - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
  - 3. Sporlan Valve Co.
- B. Replaceable Cartridge Angle Type:
  - 1. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig, and wrought copper fittings for solder end connections.
  - 2. Filter Cartridge: Pleated media with integral end rings, stainless steel support.
  - 3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumin to provide micronic filtration.
  - 4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.
- C. Permanent Straight Through Type:

1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.
2. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

## **2.9 REFRIGERANT SOLENOID VALVES**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  1. Alco Controls Div, Emerson Electric Co.
  2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
  3. Sporlan Valve Co.
- B. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, solder ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.
- C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color-coded lead wires, integral junction box.

## **2.10 REFRIGERANT EXPANSION VALVES**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  1. Alco Controls Div, Emerson Electric Co.
  2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
  3. Sporlan Valve Co.
- B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum ten (10) degrees Fahrenheit superheat. Select to avoid being undersized at full load and oversized at part load.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.2 INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- E. Install pipe identification in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Arrange refrigeration piping to return oil to compressor. Provide traps and loops in piping, and where necessary provide double risers. Slope horizontal piping 0.40 percent in direction of flow.
- H. Provide access where valves and fittings are not exposed.
- I. Flood refrigerant piping system with nitrogen when brazing.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 00.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Provide electrical connection to solenoid valves.
- R. Fully charge completed system with refrigerant after testing.
- S. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- T. Install refrigerant piping in accordance with ASME B31.5.

- U. Install piping in as short and direct arrangement as possible to minimize pressure drop.
- V. Install piping with minimum number of joints using as few elbows and other fittings as possible.
- W. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
- X. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
- Y. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
  - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
  - 2. Insulation shall be AP Armaflex pipe insulation. Provide 1-1/2 inch insulation thickness. All seams and joints shall be adhered and sealed using Armaflex 520 adhesive. All fittings shall be insulated with same insulation thickness as straight pipe.
  - 3. **Exposed refrigerant liquid and suction piping (located indoors and/or outdoors)**; shall be insulated and include two (2) coats of WB Armaflex Finish. In addition, liquid and suction lines shall be provided with aluminum jacketing; provide 0.016-inch Type 3105 on all exterior insulated piping. Fitting covers shall be 0.024-inch Type 1100 aluminum. Jacketing and fitting covers shall be banded with 0.20-inch Type 3105, 1/2-inch-wide banding with 0.32-inch Type 5005 wing seals on 12-inch centers.
- Z. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
- AA. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- BB. Slope refrigerant piping as follows:
  - 1. Install horizontal hot gas discharge piping with 1/2 inch per ten (10) feet downward slope away from the compressor.
  - 2. Install horizontal suction lines with 1/2 inch per ten (10) feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
  - 3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
  - 4. Liquid runs
- CC. Use fittings for all changes in direction and all branch connections.

- DD. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- EE. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- FF. Conceal all pipe installation in walls, pipe chases, utility spaces, above ceilings, below grade floors, unless indicated to be exposed to view.
- GG. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with one (1) inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- HH. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing or valves.
- II. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than six (6) inches shall be steel; pipe sleeves six (6) inches and larger shall be sheet metal.
- JJ. Fire Barrier Penetrations: Seal pipe penetrations through fire rated wall, partitions, ceilings, and floors, maintain the fire rated integrity.
- KK. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- LL. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.
- MM. Install moisture / liquid indicators in liquid lines between filter / driers and thermostatic expansion valves and in liquid line to receiver.
  - 1. Install moisture / liquid indicators in lines larger than 2-1/8-inch OD, using a bypass line.
- NN. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.
- OO. Install flexible connectors at the inlet and discharge connection of compressors.

### **3.3 INSTALLATION - REFRIGERANT SPECIALTIES**

- A. Refrigerant Liquid Indicators:
  - 1. Install line size liquid indicators in main liquid line downstream of condenser.
  - 2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
  - 3. Install line size liquid indicators downstream of liquid solenoid valves.
  - 4. Install liquid indicator on leaving side of filter-driers.

B. Refrigerant Valves:

1. Install service valves on compressor suction and discharge.
2. Install gage taps at compressor inlet and outlet.
3. Install gage taps at hot gas bypass regulators, inlet and outlet.
4. Install check valves on compressor discharge.
5. Install check valves on condenser liquid lines on multiple condenser systems.
6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Strainers:

1. Install line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
3. On steel piping systems, install strainer in suction line.
4. Install shut-off valves on each side of strainer.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

E. Filter-Dryers:

1. Install permanent filter-dryers in low temperature systems.
2. Install permanent filter-dryer in systems containing hermetic compressors.
3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.

F. Solenoid Valves:

1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Install in liquid line of single or multiple evaporator systems.
3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

### 3.4 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS: Brazing Manual".

1. **WARNING:** Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.
- B. Pressurize the pipe and fittings during brazing with nitrogen to prevent formation of harmful oxides.
- C. Heat joints using-acetylene torch. Heat to proper and uniform brazing temperature.

### **3.5 VALVE INSTALLTIONS - GENERAL**

- A. General: Install refrigerant valves in accordance with manufacturer's instructions.
- B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- C. Install a full sized, 3-valve bypass around each drier.
- D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.
  1. Coordinate electrical requirements and connections.
- E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
  1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
  2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
  3. Secure the bulb straps. Do not mount build in a trap or at the bottom of the line.
  4. Where external equalizer lines are required make the connection where it clearly reflect the pressure existing in the suction line at the bulb location.
- F. Install pressure regulating and relieving valves required by ASHRAE Standard 15.

### **3.6 EQUIPMENT CONNECTIONS**

- A. Install piping adjacent to machine to allow servicing and maintenance.

### **3.7 FIELD QUALITY CONTROL**

- A. Install, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.
- B. Repair leaking joints using new materials and retest for leaks.

### **3.8 CLEANING**

- A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedures:
  - 1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
  - 2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  - 3. Draw a clean, lintless cloth saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint.
  - 4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

### **3.9 ADJUSTING AND CLEANING**

- A. Verify actual evaporator applications and operating conditions and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

### **3.10 SYSTEM CHARGING**

- A. Charge system using the following procedure:
  - 1. Install core in filter dryer after leak test but before evacuation.
  - 2. Evacuate entire refrigerant system with a vacuum pump to 500 microns. When vacuum holds for a minimum of 24 hours, system is ready for charging.
  - 3. During excavation, apply heat to pockets, elbows, and low spots in piping.
  - 4. Break vacuum with refrigerant gas, allow pressure to build up to 2 psig.
  - 5. Charge system with a new filter-dryer core in charging line.
- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, trouble shooting, servicing, and preventive maintenance of refrigerant piping valves and refrigerant piping specialties.
- C. Review data in Operating and Maintenance Manuals.
- D. Schedule training with Owner with at least seven (7) days advance notice.

**END OF SECTION 23 23 00**



## **SECTION 23 25 13 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 GENERAL REQUIREMENTS**

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

#### **1.3 SCOPE**

- A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.
- B. All flushing, cleaning and initial chemical treatment shall be complete, witnessed by Owner and signed off by Owner prior to starting chillers and boilers.

#### **1.4 DESCRIPTION OF WORK**

- A. Work Included: Perform water analysis and provide all water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:
  - 1. Chilled Water Systems
  - 2. Heating Water Systems
- B. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for three months after acceptance by the Owner.
- C. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- D. Testing Equipment and Reagents: Furnish suitable water treatment equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three months after acceptance by the Owner.
- E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems and tests required. Service representative shall return to the site bi-weekly during first 2 months of operation and monthly during the remainder of the guarantee period. At such time, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.
- F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to the Owner for 1 year after

successful start-up of the system. All warranty work shall be FOB as installed at the project site.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.
2. Agreement to Maintain: Provide system produced by manufacturer who is willing to execute (with the Owner) the required agreement for continued maintenance of the system.

## 1.5 QUALITY ASSURANCE

- A. Qualifications: The Contractor for work under this Section shall have:
  1. Research and development facilities.
  2. Regional laboratories capable of making water analysis.
  3. A service department and qualified technical service representative located within a reasonable distance of the project site.
  4. Service representatives who are Registered Engineers of factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.
- B. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Use only chemicals in domestic water systems, all coincides regardless of where used, which are registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and which are labeled as required by law.
- C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.
- D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

## 1.6 SUBMITTALS

- A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.
- B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, piping and tubing sizes, fittings, accessories, valves and connections.
- C. Guarantee: Submit written guarantee signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required achieving the required performance, during a 1-year period following the final start-up or the continued operation of the chillers.
- D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four copies of an "Agreement for Continued Service and the Owner's possible acceptance." Offer terms and conditions for furnishings

chemicals and providing continued testing and equipment for a 1-year period with option for renewal of the Agreement by Owner.

## **PART 2 – PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Nalco Water / Ecolab – Danny Short, (832) 823 – 9716; danny.short@ecolab.com

### **2.2 GENERAL**

- A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.
- B. FDA and USDA Approval: use only FDA and USDA-approved products in system with direct connection to domestic water systems.
- C. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

### **2.3 CHILLED AND HEATING WATER SYSTEMS**

- A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:
1. Form a protective film to prevent corrosion and scale formation to maintain iron levels between 0.0 and 0.5 as Fe.
  2. Scavenge oxygen and protect against scale
  3. Remain stable throughout operating temperature range
  4. Are compatible with pump seals and other elements in the system.
  5. Chilled Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor 2534 compound at 650 to 750 ppm as NO<sub>2</sub> (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.
  6. Heating Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor 2534 compound at 750 to 1,000 ppm as NO<sub>2</sub> (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.
- B. Equipment: Provide a sidestream bypass feeder with a 5-gallon capacity. The feeder shall be 316 stainless steel material. Tank heads shall be a minimum of 9-gauge steel and shall be rated at 150 psi and to 250°F. Chemical feeder shall have inlet and outlet drain valves with full bottom drain.

The cap shall be 316 stainless steel industrial V band clamp style closure and shall use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. Closures using “o” rings or gaskets which are glued or restrained from free movement by snap rings shall not be considered equal.

Provide jumbo cartridge filter housing with legs to elevate the feeder off of the floor. The legs shall have holes to allow mounting to anchor bolts. Drain shall be piped to floor drain with hard pipe; PVC is not acceptable.

Cartridge Filters Housing Acceptable Manufacturers:

1. Efficiency Dynamics Model FF-50, Shelco Filters SJCH or approved equal.

C. Test Kit: Provide test kit and reagents for determining proper water conditions.

### **PART 3 - EXECUTION**

#### **3.1 PIPING SYSTEMS PREPARATION:**

- A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.
- B. Testing: Perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

#### **3.2 FLUSHING:**

- A. Drain preparation and boil out products from the systems. Flush with clean water until system tests prove systems are free of preparation and boil out products and other contaminants prior to administering system water treatment as specified hereinbefore.

#### **3.3 CHILLED AND HEATING WATER SYSTEM:**

- A. Treatment: Treat initial water charge to chilled water loop at 650-750 ppm as NO<sub>2</sub> and heating water loop at 750 to 1000 as NO<sub>2</sub> water systems, after system has been flushed and prepped, to achieve a water quality as specified.
- B. Start-up Procedures: During chilled and heating water system start-up, operate chilled and heating water treating systems (after charging with specified chemicals) to maintain the required steady-state characteristics of cooling and heating water. Demonstrate system operation to Owner's operating personnel.
- C. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:

- |    |   |      |   |  |
|----|---|------|---|--|
| 1. | D | 859  | - | Tests for Silica in Water and Water Waste  |
| 2. | D | 1067 | - | Tests for Acidity or Alkalinity of Water   |
| 3. | D | 1068 | - | Tests for Iron in Water and Wastewater   |
| 4. | D | 1126 | - | Tests for Hardness in Water  |
| 5. | D | 1128 | - | Tests for Identification of Types of Microorganisms and Microscopic Matter in Water and Wastewater |
| 6. | D | 3370 | - | Sampling Water   |

- D. Water Chemistry: Where water chemistry substantiates that pH is not necessary, chemical fee shall be based on water makeup qualities. Water analysis shall be based on the full parameters of operation, and all possible water supplies. Total hardness and "M" alkalinity of the makeup water will be the determining factor along with the technical limitations of the inhibitors.

**3.4 PERSONNEL TRAINING:**

- A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water treating systems including preparation of chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

**END OF SECTION 23 25 13**

## **SECTION 23 31 13 - METAL DUCTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and Flat Oval ducts and fittings.
  - 3. Double-wall rectangular ducts and fittings.
  - 4. Double-wall round and Flat Oval ducts and fittings.
  - 5. Double-wall flat oval / round / rectangular outdoor ductwork.
  - 6. Insulated Flexible Ducts
  - 7. Sheet metal materials.
  - 8. Sealants and gaskets.
  - 9. Hangers and supports.
- B. Related Sections:
  - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
  - 3. Division 23 Section "Duct Insulation" for internal duct liner.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### **1.4 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:
  - 1. Adhesives.
  - 2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3.  $\frac{1}{4}$ " = 1'-0" Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

**1.5 INFORMATIONAL SUBMITTALS**

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
  - a. Lighting fixtures.

- b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

## **1.6 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.
- B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment. Store ductwork inside; at no time shall ductwork be exposed.
- C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## **PART 2 - PRODUCTS**

### **2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



1. Envirotech Mechanical Systems
  2. Gurry Mechanical L.P.
  3. Letsos Company
  4. Mason Road Sheet Metal Inc.
  5. McCorvey Sheet Metal Works
  6. Telkin Sheetmetal, Inc.
  7. Tomball Sheet Metal Co.
  8. MLN
  9. Walsh & Albert
  10. Grant Sheet Metal
  11. Tennapel Sheet Metal
  12. McGill AirFlow LLC.
  13. Texas Duct Systems
  14. South Texas Sheet Metal
  15. Texas Air Duct Systems
  16. SEMCO Incorporated
  17. Lindab Inc.
  18. Linx.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Sheet Metal Connectors, Inc
- D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
  2. Gurry Mechanical L.P.
  3. Letsos Company
  4. Mason Road Sheet Metal Inc.
  5. McCorvey Sheet Metal Works
  6. Telkin Sheetmetal, Inc.

7. Tomball Sheet Metal Co.
8. MLN
9. Walsh & Albert
10. Grant Sheet Metal
11. Tennapel Sheet Metal
12. McGill AirFlow LLC.
13. Texas Duct Systems
14. South Texas Sheet Metal
15. Texas Air Duct Systems
16. SEMCO Incorporated
17. Lindab Inc.
18. Linx.

- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
  2. Gurry Mechanical L.P.
  3. Letsos Company
  4. Mason Road Sheet Metal Inc.
  5. McCorvey Sheet Metal Works
  6. Telkin Sheetmetal, Inc.
  7. Tomball Sheet Metal Co.
  8. MLN
  9. Walsh & Albert
  10. Grant Sheet Metal
  11. Tennapel Sheet Metal
  12. McGill AirFlow LLC.
  13. Texas Duct Systems
  14. South Texas Sheet Metal
  15. Texas Air Duct Systems
  16. SEMCO Incorporated
  17. Lindab Inc.
  18. Linx.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity:  $K = 0.23$  at 75 deg. F mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity:  $K = 0.23$  at 75 deg. F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Envirotech Mechanical Systems
  - 2. Gurry Mechanical L.P.
  - 3. Letsos Company
  - 4. Mason Road Sheet Metal Inc.
  - 5. McCorvey Sheet Metal Works
  - 6. Telkin Sheetmetal, Inc.
  - 7. Tomball Sheet Metal Co.
  - 8. MLN
  - 9. Walsh & Albert
  - 10. Grant Sheet Metal
  - 11. Tennapel Sheet Metal
  - 12. McGill AirFlow LLC.
  - 13. Texas Duct Systems
  - 14. South Texas Sheet Metal
  - 15. Texas Air Duct Systems
  - 16. SEMCO Incorporated
  - 17. Lindab Inc.
  - 18. Linx.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
  - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
  - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved,

duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity:  $K = 0.23$  at 75 deg F mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity:  $K = 0.23$  at 75 deg F mean temperature.

## **2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
  2. Gurry Mechanical L.P.
  3. Letsos Company
  4. Mason Road Sheet Metal Inc.
  5. McCorvey Sheet Metal Works
  6. Telkin Sheetmetal, Inc.
  7. Tomball Sheet Metal Co.
  8. MLN
  9. Walsh & Albert
  10. Grant Sheet Metal
  11. Tennapel Sheet Metal
  12. McGill AirFlow LLC.
  13. Texas Duct Systems
  14. South Texas Sheet Metal
  15. Texas Air Duct Systems

16. SEMCO Incorporated
  17. Lindab Inc.
  18. Linx.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Material:
1. Outer Duct: 18-gauge epoxy coated galvanized duct.
  2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.
- D. Inner Duct: 20 gauge perforated galvanized duct.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.
1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
- F. Exterior Coating / Finish.
1. Epoxy coated exterior duct.
  2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.
  3. Coordinate color with the architect and the owner.

## 2.6 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- a. FLEXMASTER U.S.A. Type 3.
- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
- a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
  - b. Maximum Velocity: 4,000 fpm.
  - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
  - d. Thermal Resistance: Minimum R-6 installed for interior conditioned spaces and R-8 for exterior or unconditioned spaces.
  - e. Maximum flexible duct length shall not exceed 6'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Flexible insulated ducts to be installed and secured with stainless steel worm gear clamps; nylon straps are not acceptable. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

## 2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60 (Z180).
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

## 2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
  - 10. Manufacturer: Hard cast "iron grip" Fosters 32-14 or DP-1010.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.

5. Use: O.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.9 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## **PART 3 - EXECUTION**

### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.



- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Provide removable end caps for all duct runs.**
- D. Install round ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- N. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

### **3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS**

- A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

### **3.3 REQUIREMENTS OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT**

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

### **3.5 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.

- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.7 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.8 PAINTING**

- A. Paint all exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

### **3.9 FIELD QUALITY CONTROL – DUCT LEAKAGE TEST (REQUIRED)**

- A. Perform tests and inspections. Owner and Engineer shall be present for duct pressure testing.
- B. Leakage test to be witnessed by Owner and Engineer prior to being insulated.
- C. Leakage Tests:
  - 1. Submit a test report for each test.
  - 2. Test the following systems:
    - a. Supply, Return, Exhaust and Outside air ductwork.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. **Provide Owner and Engineer (7) seven days advanced notice for testing.**

### **3.10 DUCT STORAGE / CLEANING**

- A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not

"dried-in". If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.

- B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

### **3.11 START UP**

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### **3.12 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.
- B. Supply Ducts:
  - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round: 12.
  - 2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 6.
  - 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
    - a. Pressure Class: Positive 4-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:
  - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Air-Handling and Rooftop Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 6.
  2. Ducts Connected to Air-Handling and Rooftop Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round: 6.
  3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
    - a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
    - b. Concealed: 16-gauge Carbon-steel sheet.
    - c. Continuously welded seams and joints
    - d. Pressure Class: Positive or negative 2-inch wg.
    - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - f. SMACNA Leakage Class: 3.
  4. Ducts Connected to Dishwasher Hoods:
    - a. 18-gauge Type 304, stainless-steel sheet.
    - b. Exposed to View: No. 4 finish.
    - c. Concealed: No. 2D finish.
    - d. Continuously welded seams and joints
    - e. Pressure Class: Positive or negative 2-inch wg.
    - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - g. SMACNA Leakage Class: 3.
  5. Ducts Connected to Showers and Locker Rooms:
    - a. 18-gauge Type 304, stainless-steel sheet.
    - b. Exposed to View: No. 4 finish.
    - c. Concealed: No. 2D finish.
    - d. Continuously welded seams and joints
    - e. Pressure Class: Positive or negative 2-inch wg.
    - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - g. SMACNA Leakage Class: 3.
- E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Match duct material.
3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    1. Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1,000 fpm or Lower: 90-degree tap.
  - b. Velocity 1,000 to 1,500 fpm: Conical tap.
  - c. Velocity 1,500 fpm or Higher: 45-degree lateral.

**END OF SECTION 23 31 13**

## **SECTION 23 33 00 - AIR DUCT ACCESSORIES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Back-draft dampers.
  - 2. Combination fire-and-smoke dampers.
  - 3. Duct access doors.
  - 4. Fire dampers.
  - 5. Smoke dampers.
  - 6. Volume control dampers.
  - 7. Flexible duct connections
  - 8. Duct Taps
  - 9. Duct test holes
  - 10. Flexible duct elbow supports
- B. Related Sections:
  - 1. Section 23 31 00 - HVAC Duct and Casings: Requirements for duct construction and pressure classifications.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect dampers from damage to operating linkages and blades.

## 1.6 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

## 1.7 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

## 1.8 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

## PART 2 - PRODUCTS

### 2.1 BACK-DRAFT DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Arrow United Industries
  - 2. American Warming and Ventilating
  - 3. Ruskin
  - 4. Air Balance
  - 5. NCA
  - 6. Pottorff
  - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

### 2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Ruskin
  - 2. Nailor
  - 3. Air Balance, Inc.
  - 4. Pottorff
  - 5. Price
  - 6. Greenheck
  - 7. Prefco Products
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.



- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

### **2.3 DUCT ACCESS DOORS**

- A. Acceptable Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Flex Master.
  - 2. Price.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
  - 1. Less Than 12 inches square, secure with sash locks.
  - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
  - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
  - 4. Larger Sizes: Furnish additional hinge.
  - 5. Access panels with sheet metal screw fasteners are not acceptable.

### **2.4 FIRE DAMPERS**

- A. Acceptable Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Ruskin
  2. Nailor
  3. Air Balance, Inc.
  4. Pottorff
  5. Price
  6. Greenheck
  7. Prefco Products
- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

## 2.5 SMOKE DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Ruskin
  2. Nailor
  3. Air Balance, Inc.
  4. Pottorff
  5. Price
  6. Greenheck
  7. Prefco Products
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

## 2.6 VOLUME CONTROL DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Ruskin
  2. APC, Inc.
  3. Air Balance, Inc.
  4. Nailor
  5. Price
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- C. Splitter Dampers:
1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
  2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
  3. Operator: Minimum 1/4-inch diameter rod in self-aligning, universal joint action, flanged bushing with set screw.
- D. Single Blade Dampers: Fabricate for duct height up to 12".
- E. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12" and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.
- F. Damper Blades:
1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
  2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
  3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- G. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- H. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
  2. On insulated ducts mount quadrant regulators on 2" standoff mounting brackets, bases, or adapters.
  3. Where rod lengths exceed 30 inches furnish regulator at both ends.

4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- I. Actuators:
1. Maximum damper area per actuator shall be 24 square feet face area.
  2. Actuators shall be two position or modulating spring return type.
  3. Duct mounted dampers shall have actuators mounted outside of air stream.
  4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

## **2.7 FLEXIBLE DUCT CONNECTIONS**

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Connector: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
  2. Net Fabric Width: Approximately six (6) inches wide.
  3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
  4. Install flexible connections with a minimum of one (1) inch between metal edges.
  5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

## **2.8 DUCT TAPS**

- A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.

- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

## **2.9 DUCT TEST HOLES**

- A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

## **2.10 FLEXIBLE DUCT ELBOW SUPPORTS**

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

### **3.2 INSTALLATION.**

- A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.
- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 12 x 12-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.

- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
  - 3. Install stainless steel volume dampers in stainless steel ducts.
  - 4. Install aluminum volume dampers in natatoriums.

### **3.3 DEMONSTRATION**

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

**END OF SECTION 23 33 00**

## **SECTION 23 33 19 - DUCT SILENCERS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Duct silencers.
  - 2. Crosstalk silencers.
  - 3. Ductwork lagging.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Sound control components are selected to maintain the sound level of space at levels not to exceed those listed below. The midpoint of Noise Criteria (NC) curves shall apply.
- B. Sound control components are designed to maintain rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by HVAC Applications and ANSI S1.8.
  - 1. **Offices**
    - a. Executive: 30
    - b. Conference rooms: 30
    - c. Private: 35
    - d. Open-plan areas: 35
    - e. Computer/business machine areas: 40
    - f. Public circulation: 40
  - 2. **Schools**
    - a. Lecture and classrooms: 30
    - b. Open-plan classrooms: 35
  - 3. **Libraries: 25**
  - 4. **Theaters**
    - a. Theater: 25
    - b. Stage house: 25
    - c. Trap room: 25
    - d. Orchestra pit: 25
    - e. Rehearsal rooms: 25
    - f. Teaching studios: 30
    - g. Practice rooms: 30
    - h. Ensemble rooms: 30
    - i. Shop: 45

#### **1.4 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Shop Drawings: Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Submit selection of each individual trap. Selection shall indicate airflow and pressure drop. Sound attenuators shall be selected based on full return airflow.
- E. Test Reports: Indicate acoustic housings meet or exceed specified sound transmission loss values.
- F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- G. Manufacturer's Certificate: Certify silencers meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of crosstalk silencers, acoustic housings, duct silencers and ductwork lagging. Record actual locations of hangers including attachment points.

#### **1.6 QUALITY ASSURANCE**

- A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36, standards and recommendations of ASHRAE 68.
- B. Combustion ratings for the silencer acoustic fill material shall not be greater than the following when tested to ASTM E84, NFPA Standard 255 or UL No. 723:
  - 1. Flame Spread Classification: 20
  - 2. Smoke Development Rating: 20
  - 3. Fuel Contribution: 20

#### **1.7 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.



- B. Do not deliver Equipment to the project site until progress of construction has reached the stage where sound attenuators are actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## PART 2 - PRODUCTS

### 2.1 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Industrial Acoustics
  - 2. Aerosonics
  - 3. Vibro-Acoustics
  - 4. Commercial Acoustics
  - 5. Price
  - 6. TranSonic Industries
- B. Description: Sheet metal outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal with integral interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Configuration:
  - 1. Tubular with inner casing and liner, aerodynamically shaped center body with nose cone and truncated tail cone, diameter and length as indicated on Drawings.
  - 2. Rectangular with lined splitters with radius nose and contoured tails. Size as indicated on Plans.
- D. Materials:
  - 1. Outer Casing: Minimum 22 gage thick galvanized steel stiffened with mastic filled lock formed seams, two (2) inch long, 11 gage button punched slip joints on both ends.
  - 2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.
  - 3. Fill: Glass fiber or mineral wool of minimum 3 lb/cu ft density with antimicrobial and erosion coatings.
- E. Rating:
  - 1. ASTM E477 Insertion Loss and Maximum Generated Noise based on 1000 fpm Face Velocity. Performance criteria listed below based on IAC model LFM:

Insertion Loss (dB)

Length -	Octave Band Center Frequency (Hz)						
63	125	250	500	1000	2000	4000	

Forward Flow	3 FT	4	7	13	16	15	10	9
	5 FT	6	10	17	25	25	14	11
Reverse Flow	3 FT	5	7	13	17	16	11	10
	5FT	7	12	19	27	27	14	13

Generated Noise (dB)

	Octave Band Center Frequency (Hz)							
	63	125	250	500	1000	2000	4000	
Forward Flow (all lengths)		32	24	32	25	34	39	24
Reverse Flow (all lengths)		31	30	34	35	40	45	28

2. Maximum static pressure shall not exceed 0.17 inches wg.
3. Return air silencers installed at mechanical room walls shall be sized for full design return flow to mechanical room. Outside air and exhaust air shall not be subtracted from return in order to ensure silencers operate within design parameters for all modes of operation.

**2.2 CROSS-TALK SILENCERS / TRANSFER DUCT**

- A. Description: Double wall sheet metal duct elbow with 1" insulation and perforated liner covering entire inside surface. Size as indicated on plans. Refer to Section 23 31 13 and detail on Plans.
- B. Casing: Construct elbow using duct gauges specified for size shown.
- C. Rating:
  1. Size transfer duct at a maximum of 500 fpm Face Velocity.
  2. Full design return air flow from space shall be used for sizing transfer ducts.
  3. Maximum static pressure loss through transfer duct shall not exceed 0.05 inches wg.

**2.3 DUCTWORK LAGGING**

- A. Acoustic Insulation: Two (2) inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.
- B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft. All joints of covering shall be sealed as specified.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Support duct silencers independent of ductwork.
- B. Install crosstalk silencers in wall. Pack and resiliently seal wall penetration.

- C. Lag ductwork at wall by wrapping with insulation and covering. Lagging of duct will be identified on the plans. Apply covering to be airtight. Do not attach covering rigidly to ductwork. Fire damper sleeve shall be lagged at wall penetration, no exception.
- D. Silencers shall be installed in accordance with manufacturer recommendations.
- E. Silencers installed in duct systems that generate excessive system effect and pressure drop shall be removed and installed correctly by contractor at no additional cost.
- F. Duct transition upstream of silencers shall be 30 degrees maximum. Duct transition downstream of silencer shall be 15 degrees maximum.
- G. Silencers shall be installed a distance of (3x duct diameter) from elbows.
- H. Silencers shall be installed a minimum of (1x duct diameter) from fan or unit outlets / inlets.
- I. Where multiple silencers are ganged together provide continuous galvanized steel nosing, crimped or button punched, on internal partitions.
- J. Silencers at mechanical room walls shall be installed with wall at midway point of casing. Pack and resiliently seal wall penetration. Silencers may be placed with overhang on either side of wall to allow coordination with trades.
- K. Silencers located at fire rated walls shall be connected to wall sleeve of damper. Provide duct lagging on damper sleeve.

**END OF SECTION 23 33 19**

## **SECTION 23 34 00 - HVAC FANS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
  - 1. Hooded propeller roof fans
  - 2. Upblast centrifugal roof fans
  - 3. Upblast centrifugal roof fans – Grease exhaust
  - 4. Centrifugal filtered supply fans
  - 5. Inline Fans
- C. Related Sections:
  - 1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.
  - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
  - 3. Coordinate work in this Section with Division 7.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

#### **1.5 QUALITY ASSURANCE**

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.

#### **1.6 WARRANTY**

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

#### **1.7 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
  - 1. Fan Belts: Two (2) sets for each belt-driven fan.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## **PART 2 - PRODUCTS**

### **2.1 HOODED PROPELLER ROOF FANS**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Greenheck
  - 2. Cook
  - 3. PennBarry
  - 4. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14-gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18-gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000-hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7-gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
  - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
  - 2. Direct drive units shall be provided with motor speed control option.

## 2.2 UPBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Greenheck
  - 2. Cook
  - 3. PennBarry
  - 4. Twin City
- B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast

iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
  - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
  - 2. Direct drive units shall be provided with motor speed control option.

### **2.3 UPBLAST CENTRIFUGAL ROOF FANS - GREASE EXHAUST**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Greenheck
  - 2. Cook
  - 3. PennBarry
  - 4. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Unit shall be constructed in accordance with UL 762. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An external wiring compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a 14-gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one (1) inch thick, three-pound density foil back heat shield shall be utilized to protect the motor and drive components from excessive heat. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.



- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours.
- H. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
  - 1. Disconnect Switch: Coordinate with Division 26.
  - 2. Direct drive units shall be provided with motor speed control option.
  - 3. Gravity actuated back-draft damper with adjustable counterweight.
  - 4. Provide minimum 10" tall, vented curb extension.
  - 5. Provide grease trap with drain connection.
  - 6. Provide heat baffle.
  - 7. Provide Clean-Out Port.

#### **2.4 CENTRIFUGAL FILTERED SUPPLY FAN - KITCHEN HOOD**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Greenheck
  - 2. Cook
  - 3. PennBarry
  - 4. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Description: Fan shall be a side intake, roof mounted, belt driven, centrifugal filtered supply fan.
- D. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel, bolted to a minimum 16-gauge steel fan base with pre-punched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- F. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
  - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
  - 2. Direct drive units shall be provided with motor speed control option.

## 2.5 INLINE FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Greenheck
  - 2. Cook
  - 3. PennBarry
  - 4. Twin City
- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:
  - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
  - 2. Gravity actuated back-draft damper with adjustable counterweight.
  - 3. Direct drive units shall be provided with motor speed control option.
  - 4. Companion Flanges: For inlet and outlet duct connections.
  - 5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
  - 6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

#### **3.2 INSTALLATION**

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.
- C. Install safety screen where inlet or outlet is exposed.
- D. Provide sheaves required for final air balance.
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

#### **3.3 CLEANING**

- A. Vacuum clean inside of fan cabinet.

**3.4 DEMONSTRATION**

- A. Demonstrate fan operation and maintenance procedures.

**3.5 PROTECTION OF FINISHED WORK**

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

**END OF SECTION 23 34 00**

## **SECTION 23 35 13 - SAWDUST COLLECTION SYSTEMS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Self-contained dust collector, ductwork and duct fittings, inlet fittings and collection devices, accessories.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate dimensions, sizes, weights and point loads, material thickness, and locations and sizes of field connections. Submit construction layout and details for inlet fittings.
- C. Product Data: Submit manufacturer's literature and data indicating rated capacities, dimensions, weights, and point loads. Indicate accessories, electrical characteristics, and connection requirements, wiring diagrams, and location and sizes of field connections. Submit fan curves with specified operating point plotted. Submit sound power levels for both fan inlet and outlet at rated capacity.
- D. Manufacturer's Installation Instructions: Submit: assembly and installation instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit instructions for lubrication and motor and drive replacement, spare parts list, and wiring diagrams.

#### **1.5 QUALITY ASSURANCE**

- A. The Dust Control System shall comply with the requirements of NFPA 91.
- B. Explosion venting shall comply with NFPA 68.
- C. Fan Performance:
  - 1. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
  - 2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

## 1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- B. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## 1.8 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for entire Sawdust Collection System. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.
- B. The manufacturer shall provide factory certificates for each Saw Dust Collector listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- C. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.
- D. In addition to a complete warranty, the warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, and any expenses related to service calls required to diagnose and correct warranty issues.

## 1.9 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Capacity (CFM) and static pressure (w.g.).
- Motor Horsepower.
- Fan RPM.
- Unit Power Supply: Volts / PH / Amps.
- Supply Fan Drive Type.
- Sales Order #.
- Date of unit manufactured.

## **PART 2 - PRODUCTS**

### **2.1 SAWDUST COLLECTION UNIT**

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. American Air Filter
  2. Stern-Vent
  3. Aget
  4. Donaldson Torit
  5. Ventaire
- B. Base performance on sea level conditions.
- C. Performance: Provide equipment as scheduled on Drawings.
- D. The interior and exterior of the collector housing shall have baked on power paint finish. All internal components shall have a baked on electrophoretically applied epoxy paint finish.
- E. The dust collector shall be self-contained weatherproof outdoor unit consisting of a medium efficiency, low pressure drop, centrifugal cyclone type dust separator type. Widely used for large particle sizes and heavy concentrations encountered in metalworking, rubber grinding, woodworking, and conveying of materials composed of mixed particles sizes.
- F. Equipment shall be designed for creating the necessary static pressure to collect the generated dust and to separate and discharge the dust into two (2) 55-gallon drums.
- G. The fan shall be backwardly inclined for non-overloading operation. The fan wheel shall be constructed of aluminum and fitted with a scroll for maximum efficiency and quiet operation. Fan shall be direct driven by a 3600 rpm TEFC motor. Fan and motor shall be dynamically balanced for smooth vibration free operation. The fan scroll outlet area shall be lined with a strong, smooth fiberglass laminated mat for sound attenuation. This liner shall be designed for operation at velocities up to 5000 fpm and temperature up to 250 degrees Fahrenheit and shall meet the fire resistance requirements of NFPA 90A and 90B.
- H. Motors 10 hp or larger: Electrical connection with copper split bolt connectors with rubber and electrical tape. Wire nuts are not accepted.
- I. Funnel Bottom Units shall include a steep 45-degree funnel terminating in a 12-inch diameter drum connection device without gates or doors to permit immediate down-flow

of dislodged dust into the dust disposal container. The unit shall be designed to accommodate a standard 55-gallon drum with a quick opening, positive seal device to prevent air or dust leakage. Provide two (2) 55-gallon drums.

- J. A controller shall be furnished, consisting of on/off push buttons in a NEMA 12 enclosure.
- K. The collector shall be fully assembled and ready for installation and wiring. Protective packaging shall consist of a complete plastic wrap and skeleton crating.
- L. Dust collectors with bags or shakers are not acceptable.
- M. Collector shall be equipped with an integral explosion vent and provided with a no return explosion isolation valve.
- N. Collector frame and all exterior components shall be hot dipped galvanized or epoxy coated for corrosion resistance.
- O. Discharge muffler / attenuator for sound.

**2.2 DUCTWORK AND DUCT ACCESSORIES – PROVIDED AND INSTALLED BY MECHANICAL CONTRACTOR**

- A. Interior of all ducts shall be smooth and free from obstructions with joints welded. Minimum design velocity is 4000 FPM.
- B. Ducts shall be constructed of galvanized sheet steel, lock-forming quality, G90 zinc coating in conformance with ASTM A90/A90M. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards. Exterior ductwork shall be painted with two coats of enamel. Paint color by architect.
- C. Construct all fittings (T's, elbows, etc.) with minimum radius two times duct width at centerline.
- D. Increase duct sizes gradually, not exceeding 10 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Prime coat welded joints.
- F. Use unistrut to properly support ductwork.
- G. The following metal thickness shall be supplied:

Diameter of Straight Ducts	U.S. Standard Gauge for Class 2 Duct
0 inch - 8 inches	20
Over 8 inches to 18 inches	18
Over 18 inches to 30 inches	16
Over 30 inches	14
- H. Where flexible piping is necessary, a non-collapsible type of flexible piping shall be used, and it shall be kept at a 6'-0" maximum length.
- I. Blast Gates: Full collar of cast aluminum, with galvanized steel slide, set screw installed at 4'-0" A.F.F. Required on all drops to equipment.



- J. Floor sweeps shall have expandable metal installed at inlet to prevent large debris from entering ductwork.

### **2.3 INLET FITTINGS**

- A. Fabricate of minimum 16 gage galvanized steel.
- B. Fabricate with hemmed edges, closed corners, and reinforced for span and attachment, with duct connection.

### **2.4 EXPLOSION VENTING**

- A. Provide explosion isolation valves in suction side of ducts to prevent deflagration propagation between connected equipment in accordance with NFPA 69: Standard on Explosion Prevention Systems.
- B. Explosion isolation valves shall be located in suction side of duct outside of the building.
- C. The size and number of explosion vents used shall be in accordance with NFPA-68.
- D. When relief devices cannot provide sufficient pressure relief, duct shall be designed to withstand an internal pressure of not less than 100 pound per square inch.
- E. Ductwork between the duct collector and explosion isolation valve must be a minimum of two gauges heavier than the ductwork upstream of the explosion isolation valve.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install flexible connection at dust collection unit inlet. Install metal bands of connectors parallel with minimum one (1) inch flex between bands while running. Refer to Section 25 05 48.
- B. Install Pitot tube openings at locations required for testing of systems, complete with metal cap with spring device or screw to prevent against air leakage. Refer to Section 25 05 48.
- C. Provide blast gate at every drop to equipment.
- D. All equipment shall be installed in accordance with the manufacturer's recommendations and printed instructions.
- E. All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.
- F. Longitudinal joints of ducts shall be lapped and welded.
- G. Girth joints of ducts shall be made with lap in direction of air flow, with one (1) inch lap, diameters thru 19 inch.
- H. Elbows and angles shall have an inside or throat radius of two pipe diameters. Large radii are recommended for heavy concentrations of highly abrasive dusts. Construct elbows

six (6) inches or less in diameter of at least five (5) sections. Angles shall be pieced proportionately.

- I. Hoods must be free of sharp edges or burrs and reinforced to provide necessary stiffness. Owner to provide all equipment under hoods. Contractor shall make final equipment hood connections. Terminate all exhaust drops to equipment 6 feet-0 inches above floor. Provide dead ends caps within six (6) inches from last branch of all mains and sub-mains.
- J. Provide cleanouts every ten (10) feet and near each elbow, angle, or duct junction in horizontal sections. Provide safety implosion gate in main duct to prevent duct collapse in the event all gates are closed.
- K. Support ducts sufficiently to place no load on connecting equipment and to carry weight of system if plugged with material. Maximum supporting interval 12 feet for eight (8) inches or smaller ducts; 16 feet intervals for large ducts.
- L. Provide six (6) inches minimum clearance between ducts and ceiling, wall, or floors.
- M. All branches shall enter the main at the large end of the transition at an angle not exceeding 45 degrees. Connect branches only to top or sides of main, with no two branches entering diametrically opposite.
- N. Connect dust to dust collection machine inlet with split sleeve draw band one pipe diameter long but not less than five (5) inches.
- O. Transitions in mains and sub-mains to be tapered; taper five (5) inches long for each one (1) inch change in diameter is recommended.
- P. Place blast gates for adjustment of system near connection of branch to main. Provide means of locking after adjustments have been made.

### **3.2 INTERFACE WITH OTHER PRODUCTS**

- A. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

### **3.3 PROTECTION OF INSTALLATION**

- A. Do not operate sawdust collection systems until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

**END OF SECTION 23 35 13**

## **SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes: Air devices.

#### **1.3 REFERENCES**

- A. Air Movement and Control Association International, Inc.:
  - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
  - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of air outlets and inlets.

#### **1.6 QUALITY ASSURANCE**

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## PART 2 - PRODUCTS

### 2.1 AIR DEVICES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Titus.
  - 2. Metalaire.
  - 3. Nailor.
  - 4. Krueger.
  - 5. Price.
- B. Mounting:
  - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.
  - 2. "T" Bar Ceilings: Lay-in type.
  - 3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.
- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.
  - 1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".

2. Shall have a fire resistance rating of 3 hours.
  3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.
  4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
  5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.
  6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
1. Square to round neck adapter.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify inlet and outlet locations.
- B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

#### **3.2 INSTALLATION**

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.
- C. Install diffusers, registers, and grilles level and plumb.

- D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

### **3.3 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

### **3.4 INTERFACE WITH OTHER PRODUCTS**

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

### **3.5 SCHEDULES:**

- A. Refer to Drawings.
- B. **No perforated supply or return grilles will be allowed; return air grilles to be louvered with ¾" spacing 45° deflection, white finish.**

**END OF SECTION 23 37 13**

## **SECTION 23 37 23 - HVAC GRAVITY VENTILATORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
  - 1. Dryer vent roof cap
  - 2. Roof mounted intake hood
  - 3. Roof mounted relief hood
- C. Related Sections:
  - 1. Section 23 31 00 - HVAC Duct and Casings: Product requirements for hangers for placement by this section.
  - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
  - 3. Coordinate work in this Section with Division 7.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork, and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

#### **1.5 QUALITY ASSURANCE**

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

## **1.6 WARRANTY**

- A. Furnish one (1) year manufacturer's warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Ventilators shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

## **PART 2 - PRODUCTS.**

### **2.1 DRYER VENT ROOF CAP**

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Ruskin Co.
  - 2. Greenheck
  - 3. Louvers and Dampers, Inc.
  - 4. Price
- B. Unit shall be a spun aluminum, roof mounted gravity ventilator.



- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories: Gravity actuated back-draft damper with adjustable counterweight.

## 2.2 ROOF MOUNTED INTAKE HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Ruskin.
  - 2. Greenheck.
  - 3. Louvers and Damper, Inc.
  - 4. Price.
- B. Unit shall be an aluminum roof mounted intake hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Birdscreen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, and factory installed nailer strip. Coordinate installation with Division 7.

## 2.3 ROOF MOUNTED RELIEF HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Ruskin.
  - 2. Greenheck.
  - 3. Louvers and Damper, Inc.
  - 4. Price.
- B. Unit shall be an aluminum roof mounted relief hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Bird screen constructed

of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
  - 1. Gravity actuated back-draft damper with adjustable counterweight.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

#### **3.2 INSTALLATION**

- A. Secure intake/relief hoods with cadmium plated steel lag screws to roof curb structure.
- B. Install safety screen where inlet or outlet is exposed.

#### **3.3 MANUFACTURER'S FIELD SERVICES**

- A. Furnish services of factory trained representative for minimum of one (1) day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

#### **3.4 CLEANING**

- A. Vacuum clean inside of fan cabinet.

#### **3.5 DEMONSTRATION**

- A. Demonstrate fan operation and maintenance procedures.

#### **3.6 PROTECTION OF FINISHED WORK**

- A. Do not operate until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

**END OF SECTION 23 37 23**

## **SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Category I Type B double wall metal vents.
  - 2. Category IV Condensing Appliance double wall metal vents.
  - 3. Category III Double wall metal stacks.
  - 4. Double wall engine exhaust.
- B. Related Sections:
  - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers and supports for placement by this section.

#### **1.3 REFERENCES**

- A. Underwriters Laboratories Inc.:
  - 1. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
  - 2. UL 378 - Draft Equipment.
  - 3. UL 441 - Gas Vents.
  - 4. UL 641 - Type L Low-Temperature Venting Systems.
  - 5. UL 959 - Medium Heat Appliance Factory Built Chimneys.

#### **1.4 DESIGN REQUIREMENTS**

- A. Design refractory lined metal stacks for wind loading of 110 mph.

#### **1.5 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. **Flue pipe shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.**
- C. Manufacturer shall provide a 1/4" = 1'-0" scaled drawing within submittal showing flue pipe routing in plan and elevation views. Drawing of flue routing must be provided with dimensions showing code required distances away from intake hoods, intake louvers, etc. Include dimensions from finished roof to top of flue. Flue gasses discharged must not recirculate back into building by winds or inadequate spacing between any building envelope intakes.

- D. Product Data: Submit data indicating factory-built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics, and connection requirements.
- E. Product Data: Submit data on draft fans and accessories including fan curves with specified operating point plotted, power, RPM, and electrical characteristics and connection requirements.
- F. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.6 QUALITY ASSURANCE**

- A. All products furnished under this Section shall conform to the requirements of NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL and cUL listing mark or label.
- B. Flue pipe shall be provided and submitted by boiler manufacturer submitting on project.

#### **1.7 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

#### **1.8 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain water integrity of roof during and after installation of chimney or vent.

### **PART 2 - PRODUCTS**

#### **2.1 CATEGORY IV CONDENSING APPLIANCE DOUBLE WALL METAL VENTS**

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Vent Product Company
  - 2. Metal-Fab inc.
  - 3. Protech Systems, Inc.
  - 4. Metalbestos
  - 5. Van Packer
  - 6. Schebler
  - 7. Duravent
- B. Fabrication: Inner pipe of sheet AL29-4C and outer pipe of 430 stainless steel, tested in compliance with UL 441.
- C. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, NFPA-54; and NFPA-211, the Standard for Positive Pressure Condensing Appliances. Products shall be listed to UL-441 and shall carry the appropriate UL or cUL listing mark or label.

- D. The vent shall be of the double-wall, factory-built type for use with approved Category IV condensing appliances burning natural or LP gas, which produce flue gases exhausted at temperatures not exceeding 550° F.
- E. The vent shall be constructed of an outer wall of 430 stainless steel, .018" thick for sizes 3" to 14" diameter, and .024" thick for sizes 16" to 30"diameter. The inner wall shall be constructed of AL29-4C, .035" thick for sizes 3" to 8" diameter and .048" thick for sizes 10" to 30" diameter. The vent shall include an integral, annular insulating air space, 1/4" thick for sizes 3" to 6" diameter and 1/2" thick for sizes 7" to 30" diameter.
- F. Edges of inner and outer walls shall be sealed and joined according to manufacturer installation instructions.
- G. All fittings, flashing, storm collar, cap, and appliance adapter required to install the vent shall be included.
- H. Vent shall be tested and listed for a minimum clearance to combustibles of 1" for sizes 3" to 24" diameter and 2" for sizes 26" to 30" diameter.
- I. Vent shall terminate as required by code.
- J. Vent shall be installed in accordance with the vent manufacturer's installation instructions, UL listing and state or local codes.
- K. Warranty: Furnish 1-year manufacturer warranty for manufactured units to begin at substantial completion.
- L. Required Accessories, UL labeled:
  - 1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
  - 2. Stack Cap: Consists of conical rain shield with inverted cone for partial rain protection with low flow resistance.
  - 3. Exterior pipe and fittings shall be constructed entirely of type 304 stainless steel.
- M. Application: Category IV Condensing Gas Appliances.

### **PART 3 - EXEXECUTION**

#### **3.1 PREPARATION**

- A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

#### **3.2 INSTALLATION - GENERAL**

- A. Install in accordance with NFPA 54.
- B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- C. All double wall gas vents maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories for complete installation.

- D. Install vent dampers, locating close to draft hood collar, and secured to breeching.
- E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- F. Level and plumb chimney and stacks.
- G. Clean breeching, chimneys, and stacks during installation, removing dust and debris.
- H. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.
- I. Provide the appropriate and/or applicable chimney system continuous from appliances.

### **3.3 ENGINE EXHAUST AND BOILER STACK**

- A. Installation shall conform to the manufacturer's installation instructions, UL listing and state or local codes.
- B. Support system from building structure using rigid structural shapes for attachment of fixed point supports (Plate Support Assembly). Anchor supports to structure by welding to inserts, bolting, steel expansion anchors or concrete inserts. Size of structural shapes shall be in accordance with manufacturer's recommendations.
- C. Protect incomplete installations by attaching temporary closures over open ends of sections.
- D. Clean all system sections of dust and debris prior to final connection to appliances.
- E. Maximum unsupported horizontal spacing shall be nine (9) feet between guides.
- F. Maximum unsupported vertical spacing shall be 19 feet between guides.
- G. Pipe to be routed to minimize flow resistance.
- H. Provide double wall bellows joint between each support and for every three (3) inches of expected expansion.
- I. Provide support at roof penetration to support free standing of exhaust above roof and to keep stack centered in ventilated thimble assembly.
- J. Provide drain bucket at bottom of vertical stack, piped to nearest floor drain.
- K. Provide ventilated thimble and storm collar at roof penetration.
- L. Provide flip top fitting at stack termination or engine exhaust.
- M. Provide stack cap on boiler stack termination.

**END OF SECTION**

## **SECTION 23 52 16 - CONDENSING BOILER**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Heating water boiler heat exchanger.
  - 2. Boiler control panel.
  - 3. Hot water boiler trim.
  - 4. Natural gas fired burner.
- B. Boiler shall be completely factory assembled and tested on a structural steel base and be ready for water, gas, and electric connections.
- C. Boiler and all components shall be CSA certified.
  - 1. ASME Section IV (Heating Boilers)
  - 2. ANSI Z21.13 / CSA 4.9 (Gas Fired Low Pressure Boilers)
  - 3. NFPA 54 (ANSI Z221.3) National Fuel Gas Code
  - 4. ASME CSD-1 (Controls and Safety Devices)
- D. Related Sections:
  - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolators for placement by this section.
  - 2. Section 23 11 23 - Gas Piping: Execution requirements for gas piping connections to boilers specified in this section.
  - 3. Section 23 51 00 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.
  - 4. Division 26 - Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

#### **1.3 REFERENCES**

- A. ASME Section IV (Heating Boilers)
- B. ANSI Z21.13/CSA 4.9 (Gas Fired Low Pressure Boilers)
- C. NFPA 54 (ANSI Z221.3) National Fuel Gas Code

- D. ASME CSD-1 (Controls and Safety Devices)

#### 1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Flue pipe as specified per 23 51 00 Breechings, Chimneys, and Stacks, shall be provided, and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.**
- C. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.
- D. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test.
- E. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

#### 1.6 QUALITY ASSURANCE

- A. Conform to ASME Section IV for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.
- B. Gas Train and Safety Controls: Industrial Risk Insurers.
- C. Unit Certification: CSA certified.
- D. Boilers shall comply with 2012 International Energy Conservation Code.

#### 1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Boilers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water



migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

#### **1.9 WARRANTY**

- A. The boiler manufacturer shall provide a complete five (5) year full parts and labor warranty. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.
- B. Provide an extended parts and labor warranty for the following:
  - 1. Pressure Vessel, Burner and Heat Exchanger: Ten (10) years from date of substantial completion.
  - 2. Thermal shock: Ten (10) years from date of substantial completion.
- C. In addition to entire parts and labor warranty, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, and any expenses related to service calls required to diagnose and correct warranty issues.
- D. The manufacturer shall provide factory certificates for each boiler listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

#### **1.10 PREVENTATIVE MAINTENANCE SERVICE**

- A. Furnish service and maintenance of boilers for one (1) year from Date of Substantial Completion.

- B. Provide quarterly inspections, four (4) per year, by factory direct technician. Provide the owner a minimum of one week's notice prior to inspection.
- C. Provide emergency call back service at all hours for this maintenance period.
- D. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- E. All maintenance work shall be performed by factory direct service technician. Maintenance work shall not be performed by installing mechanical contractor.

#### 1.11 GENERAL

- A. Each factory "packaged" boiler shall be complete with all components, accessories and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.
- B. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

#### PART 2 – PRODUCTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Hydrotherm: KN Series
  - 2. Raypak: XVers
  - 3. Patterson-Kelley: Solis
  - 4. RBI: Flexcore
  - 5. Lochinvar: Crest
  - 6. Viessman: VitoCrossal
- B. **Provide fire tube condensing boilers only.**

#### 2.2 HEATING WATER BOILERS

- A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 97 % on 500 MBH input boilers and less and not less than 97% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68° F.
- B. Boiler shall comply with ASME Section IV for 80 psig, max 200° F (100 psig on 1500 MBH and larger units).

- C. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 in.wc. to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 in.wc.

### 2.3 BOILER DESIGN

- A. Each hot water boiler shall consist of a stainless-steel or cast-iron primary only heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified. Boilers requiring a secondary heat exchanger (economizer) to achieve condensing operation will not be permitted as well as copper-finned heat exchangers.
- B. Each boiler heat exchanger shall be stainless-steel or cast iron, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section.
- C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.
- D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.
- E. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 deg F service. Push nipples or gaskets between the sections are not permitted.
- F. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16-gauge carbon steel. The front and top wall shall be secured in place with ¼ - 20 NC bolts (sheet metal screws are not acceptable). The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50°F above ambient temperature when the boiler is operated at full rated load.
- G. An observation port shall be located on the boiler to allow for observation of the burner flame.
- H. Flue gas outlet shall be located on the rear of the boiler. Boiler to be certified for installation with Category IV venting (stack) as defined in NFPA 54 (ANSI Z221), latest edition. Contractor must provide venting (stack) certified for installation on a Category IV appliance.

### 2.4 BOILER TRIM

- A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
  - 1. Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.
  - 2. Water pressure-temperature gauge.
  - 3. Primary low water flow fuel cutoff (probe type with manual reset).

4. Manual reset high limit water temperature controller.
5. Operating temperature control to control the sequential operation of the burner.

## **2.5 BOILER FUEL BURNING SYSTEM**

- A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.
- B. Each burner shall be provided with an integral gas firing combustion head.
- C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.
- D. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall be a maximum of 900 watts and operate at 6,000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the LED display.
- E. Each burner shall of the radial-fired (down-fired) type and constructed of steel with a stainless-steel inner and stainless-steel mesh outer screen.
- F. Each boiler shall be provided with a "Full Modulating" firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.
- G. The Micro Processor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:
  1. Maintain single set point
  2. Reset the set point based on outdoor air temperature.
  3. Boiler shutdown based on outdoor air temperature.
  4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)
  5. Alarm relay for any for any manual reset alarm function.
  6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.

7. LED Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.
8. Local Manual Operation.
9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate.
10. Computer (PC) interface for programming and monitoring all functions

## **2.6 MAIN GAS VALVE TRAIN**

- A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
  1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
  2. Air – Gas ratio control (maximum inlet pressure 14 in.wc.)
  3. One (1) low gas pressure switch (manual reset).
  4. One (1) high gas pressure switch (manual reset).
  5. Two (2) pressure test ports.

## **2.7 IGNITION SYSTEM**

- A. Each boiler shall be equipped for direct spark ignition.

## **2.8 COMBUSTION AIR CONTROL**

- A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
  1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.
  2. One (1) low airflow differential pressure switch to ensure that combustion air is supplied.
  3. High exhaust back pressure switch

## **2.9 BURNER CONTROL SYSTEM**

- A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the MCC (supplied by contractor).

- B. The boiler shall include an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.
- C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.
- D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

#### **2.10 BURNER CONTROL PANEL**

- A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
  - 1. One (1) burner "on-off" switch.
  - 2. One (1) electronic combination temperature control, flame safeguard and system control.
  - 3. Control circuit breaker, 5 amp
  - 4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
  - 5. LED Display Panel to adjust set points and control operating parameters. LED display to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, and sensor values such as inlet, outlet, flue gas and outdoor air.

#### **2.11 BUILDING AUTOMATION SYSTEM INTERFACE:**

- A. Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
  - 1. A BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

#### **2.12 FACTORY TESTING – HYDROSTATIC**

- A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME "H" stamp.

#### **2.13 FACTORY TESTING – FIRE TESTING**

- A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install boilers plumb and level, to plus or minus 1/16 inch over boiler base. Stacking of boilers is unacceptable.
- B. Maintain manufacturers recommended and code minimum clearances around and over boilers.
- C. Install boiler on concrete housekeeping pad, minimum four (4) inches high and six (6) inches larger than boiler base on each side. Refer to Section 23 05 29 - Hangers and Supports For HVAC Piping and Equipment.
- D. Install boiler on vibration isolators in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- E. Connect natural gas piping in accordance with NFPA 54.
- F. Connect natural gas piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances and unions for burner removal and service.
- G. Connect hot water piping to supply and return boiler connections.
- H. Install the following piping accessories. Refer to Section 23 05 19 - Meters and Gages For HVAC Piping.
  - 1. On supply:
    - a. Thermometer well for temperature controller.
    - b. Thermometer well and thermometer.
    - c. Well for control system temperature sensor.
    - d. Strainer.
    - e. Nipple and flow switch.
    - f. Pressure gage.
    - g. Shutoff valve.
  - 2. On return:
    - a. Thermometer well and thermometer.
    - b. Well for control system temperature sensor.
    - c. Pressure gage.
    - d. Shutoff valve.
    - e. Balancing valve.

- I. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23 - Gas Piping.
  - 1. Strainer.
  - 2. Pressure gage.
  - 3. Shutoff valve.
  - 4. Check valve.
  - 5. Pressure reducing valve.
  - 6. Unions.
- J. Install discharge piping from relief valves and drain valves to nearest floor drain.
- K. Install boiler trim and accessories furnished loose for field mounting.
- L. Install electrical devices furnished loose for field mounting.
- M. Install control wiring between boiler control panel and field mounted control devices.
- N. Connect flue to boiler outlet, full size of outlet.
- O. Route each gas trim vent, separately, to the outdoors. Vent lines sizes shall be a minimum the equivalent size pipe connection. Provide union at each device to facilitate change-out and in the vertical to allow the burner door to swing open. Terminate vents a sufficient distance from air intakes, turn down and provide insect screen.
- P. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

### **3.2 FIELD QUALITY CONTROL**

- A. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent NOx, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.
- B. Arrange with local authorities having jurisdiction for inspection of boiler, piping, and for certificate of operation. Provide written certification from boiler manufacturer that installation is in compliance with manufacturer's written instructions.
- C. Prior to boiler startup, Contractor to inform Owner to have boiler inspector inspect installation for proper installation and submit for State Operating Certificate.

### **3.3 BOILER INSPECTION REQUIREMENTS**

- A. All new boilers, regardless of new construction or renovation of existing systems, are required to receive inspection by a state boiler inspector or their assigned agent prior to any boiler being energized, no exceptions. A boiler requiring inspection is generally defined by the following characteristics:
  - 1. Heat input exceeds 200,000 Btuh.



2. Nominal water-containing capacity exceeds 120 gallons.
- B. Installing contractor shall go on-line to <http://www.license.state.tx.us/boilers/blrforms.htm> and provide completed boiler installation report and temporary boiler operating permit forms at substantial completion.
- C. As per Boiler Safety Administration Rules, 65.20, The Owner or operator are the only persons that can submit a request for inspection of a boiler by the state or their agent. The inspection agent has at least 30 days to schedule an inspection date with the Owner. During an emergency situation where a boiler is replaced due to mechanical failure of an existing boiler, the agent may grant approval to the Owner to allow startup before inspection but that is at the agent's discretion. Late fees incurred by the owner after 30 days period shall be repaid by mechanical contractor.
- D. The installing contractor is required to submit the following documents to the Owner before the Owner can submit for state inspection.
1. Contractor shall complete the attached Boiler Inspection Installation Report and notify the district HVAC department personnel in charge of maintaining all inspection certification documentation for the district.
  2. Contractor shall submit all manufacturer's cut sheets and product information on boiler being inspected.
  3. Hydrostatic test results on boiler being inspected.
  4. Contractor shall submit this information to the Owner in a timely manner so the inspection can be scheduled and performed prior to project completion.
- E. As per the Health and Safety Code, Chapter 755, September 1, 2003;
1. Nuclear, high pressure or steam boilers must receive an annual certificate of inspection and an annual external inspection if they meet these characteristics:
    - a. Pressures exceeding 160 psi.
    - b. Temperatures exceeding 250 degrees Fahrenheit
  2. Steam heating boilers and hot water heating boilers shall be inspected biennially (every two years) if they meet these characteristics:
    - a. Pressures not exceeding 160 psi.
    - b. Heat input exceeds 200,000 Btuh.
    - c. Water temperature greater than 210 F but not greater than 250 degrees Fahrenheit
    - d. Nominal water-containing capacity exceeds 120 gallons.
  3. Hot water supply boilers shall be inspected triennially (every three years) if they meet these characteristics:
    - a. Pressures not exceeding 160 psi.

- b. Heat input exceeds 200,000 Btuh.
- c. Water temperature not exceeding 210 degrees Fahrenheit; or Nominal water-containing capacity exceeds 120 gallons.

F. Inspection Responsibilities

- 1. Preparing the boiler for inspection is listed in the Boiler Safety Administrative Rules, Section 65.70;
  - a. Water shall be drawn off and the boiler thoroughly washed.
  - b. All manhole and hand hole plates, washout plugs, and plugs in the water column connections shall be removed as necessary for complete inspection. The furnace and combustion chambers shall be thoroughly cooled and cleaned.
  - c. All grates and internally fired boilers shall be removed.
  - d. Brickwork shall be removed as required by the inspector in order to determine the condition of the boiler, headers, furnace, supports or other parts.
  - e. The pressure gage shall be removed for cleaning of the siphon and testing, if necessary.
  - f. The low water cutoff device shall be dismantled, cleaned and prepared for inspection.
  - g. Before removing the manhole or hand hole covers and entering any part of the boiler connected to a common header with other boilers any leakage of steam or hot water shall be eliminated. The non return and stop valves must be closed, tagged, and preferably padlocked, and drain valves between the two valves opened. The feed water valves must be closed, tagged and preferably padlocked. After draining the boiler, the blowdown valves shall be closed and preferably padlocked. Blowdown lines, where practicable, shall be disconnected between pressure parts and valves. All vent and drain lines shall be opened.
  - h. If the boiler is jacketed so that the seams of shells, drums or domes cannot be seen, enough of the jacketing, setting wall, or other form of casing or housing shall be removed to permit inspection to determine the safety of the boiler, provided such information cannot be determined by other means.
- 2. For initial boiler inspection after installation:
  - a. Once an inspection date has been established between the inspector and Owner, the boiler manufacturer's representative shall be available on-site for boiler inspection.
  - b. The manufacturer's representative shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.

- c. The manufacturer's representative will be responsible to re-assemble boiler back to its original state and then schedule a startup test with the installing contractor and Owner. All product warranties shall begin once startup has been completed and unit is available for use as designed.

3. For annual boiler inspection:

- a. Once an inspection date has been established between the inspector and Owner, the Owner or their assigned contractor shall be available on-site for boiler inspection.
- b. The Owner or their assigned contractor shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.
- c. The Owner or their assigned contractor will be responsible to re-assemble boiler back to its original state and place the boiler in good working condition.

**3.4 MANUFACTURER'S FIELD SERVICES**

- A. Start-up boilers according to manufacturer's start-up instructions and in presence of boiler manufacturer's representative as well as Owner and Engineer. Test controls and demonstrate compliance with requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

**3.5 CLEANING**

- A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

**3.6 ON-SITE DEMONSTRATION**

- A. Demonstrate operation and maintenance procedures.
- B. Furnish services for manufacturer's technical representative for one (1) 8-hour day to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least seven (7) days notice to Architect/Engineer of training date.

**3.7 CARBON MONOXIDE MONITORING SYSTEM**

- A. Refer to specification 23 09 23 Direct Digital Controls for additional information.

**END OF SECTION 23 52 16**

## **SECTION 23 63 13 - AIR-COOLED REFRIGERANT CONDENSERS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes refrigerant condenser package, charge of refrigerant and oil, controls and control connections, refrigerant piping and connections, motor starters, electrical power connections.
- B. Related Sections:
  - 1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolation for placement by this section.
  - 2. Section 23 00 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified by this section.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils.

#### **1.4 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each air-cooled refrigerant condenser. Include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights, and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Shop Drawings: For air-cooled refrigerant condensers. Include plans, elevations, sections, details, and attachments to other work.
    - A. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    - B. Wiring Diagrams: For power, signal, and control wiring.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members to which air-cooled refrigerant condensers will be attached.
  - 2. Liquid and vapor pipe sizes.

3. Refrigerant specialties.
4. Piping including connections, oil traps, and double risers.
5. Evaporators.

B. Field quality-control reports.

#### **1.6 CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For air-cooled refrigerant condensers to include in emergency, operation, and maintenance manuals.

#### **1.7 QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

#### **1.8 COORDINATION**

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate location of refrigerant piping and electrical rough-ins.

#### **1.9 QUALIFICATIONS**

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

A. Equipment shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to

the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

### 1.11 WARRANTY

- A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start date from shipment or start up will not be acceptable.
- B. In addition to full machine parts, labor and refrigerant, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.
- C. The manufacturer shall provide factory certificates for each condensing unit listing as a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- D. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

## PART 2 - PRODUCTS

### 2.1 AIR-COOLED REFRIGERANT CONDENSERS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - 1. Carrier.
  - 2. Daikin.
  - 3. JCI.
  - 4. Trane.
- B. Product Description:
  - 1. Self-contained packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, compressors, and controls. Each unit shall consist of hermetic scroll compressor air-cooled condenser section.

2. Construction and Ratings: In accordance with ARI 210/240. Testing in accordance with ASHRAE 20.
3. Air-Cooled Refrigerant Condensing units shall be the same manufacturer as associated Air Handling Unit or Fan Coil Unit. Mismatched equipment is not acceptable.

## 2.2 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
  - Unit identification as indicated within Contract Documents.
  - Serial Number.
  - Model Number.
  - Nominal tonnage.
  - Motor Horsepower.
  - Unit Power Supply: Volts / PH / Amps; MCA / MOCP
  - Refrigerant type.
  - Sales Order #.
  - Date of unit manufactured.

## 2.3 HOUSING

- A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel with full opening access doors. Furnish mechanical interlock to disconnect power when door is opened.
- C. Furnish removable access doors or panels with quick fasteners. Units over 25 tons shall be provided with piano hinges and quick fasteners.
- D. Furnish welded steel floor mounting stand and duct collars at coil inlet and fan outlet.

## 2.4 CONDENSER COILS

- A. Microchannel design. Furnish sub-cooling circuits as applicable. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen or refrigerant.
- B. Compressors:
  1. Scroll type, hermetically sealed.
  2. Minimum of 2 compressors for units 7.5-tons or larger.
  3. Minimum of 4 compressors for units 15-tons or larger.
  4. Refrigerant shall be R-32.
  5. All scroll compressors shall include Internal Pressure Relief as standard.
  6. For each compressor provide starter, non recycling compressor overload, starter relay, and control power transformer or terminal for control power. Provide manual reset current overload protection.
- C. Provide compressor with minimum 2-stages of cooling.
- D. Unit shall be able to operate down to 10 degrees Fahrenheit ambient temperature as standard.

- E. Coil Guard: louvered with lint screens.
- F. Configuration: Two refrigeration circuits each with receiver.

## **2.5 REFRIGERANT CIRCUIT**

- A. Single Compressor: One refrigerant circuit with single compressor.
- B. Multiple compressors: Each compressor shall have an isolated refrigerant circuit piped such that burn out of one compressor shall not damage the other compressor(s). Compressors shall not be piped in parallel arrangement into one refrigerant circuit.
- C. Furnish for each refrigerant circuit:
  - 1. Liquid line solenoid valve.
  - 2. Filter dryer (replaceable core type without refrigerant loss or removal).
  - 3. Liquid line sight glass and moisture indicator.
  - 4. Electronic expansion valve.
  - 5. Charging valve.
  - 6. Insulated suction line.
  - 7. Discharge line check valve.
  - 8. Compressor discharge service valve.
  - 9. Condenser Pressure relief valve.
  - 10. Suction and liquid line service valves.

## **2.6 FANS AND MOTORS**

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge, equipped with roller or ball bearings with grease fittings extended to outside of casing.
- B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built-in current and thermal overload protection.

## **2.7 CONTROLS**

- A. Factory wired and mounted control panel, NEMA 3R, containing fan motor starters, fan cycling thermostats, head pressure controls, compressor interlock and control transformer.
- B. Furnish controls to permit operation down to 10 degrees Fahrenheit ambient temperature.
- C. Furnish thermostat to cycle fan motors in response to outdoor temperature.
- D. Furnish head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
- E. Furnish solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
- F. Furnish electronic low ambient control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.



- G. Furnish following safety controls arranged so that operating anyone will shut down machine:
  - 1. High discharge pressure switch (manual reset).
  - 2. Low suction pressure switch (automatic reset).
  - 3. Oil pressure switch (manual reset).
  - 4. Provide a timed off cycle.

## **2.8 CONDENSING UNIT PERFORMANCE**

- A. Provide equipment with capacity as scheduled on Drawings.

## **2.9 ELECTRICAL CHARACTERISTICS AND COMPONENTS**

- A. Electrical Characteristics: Provide equipment with electrical characteristics as shown on Electrical Drawings.
- B. Disconnect Switch: Coordinate with Division 26, Electrical.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with ASHRAE 15.
- B. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- C. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties specified in Section 23 23 00 - Refrigerant Piping.
- D. Install connection to electrical power wiring in accordance with Division 26.

### **3.2 INTERFACE WITH OTHER PRODUCTS**

- A. Install units on vibration isolators on 4" tall concrete housekeeping pad. Refer to 23 05 29 Hangers and Supports for HVAC Piping and Equipment and 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.

### **3.3 MANUFACTURER'S FIELD SERVICES**

- A. Furnish cooling season start-up and winter season shutdown service, for first year of operation. If initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

### **3.4 DEMONSTRATION AND TRAINING**

- A. Demonstrate starting, maintenance, and operation of unit.
- B. Demonstrate low ambient operation during winter testing or service specified above.

**END OF SECTION 23 63 13**

## **SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes modular factory fabricated air-handling units and accessories.
- B. Related Sections:
  - 1. Section 23 05 00 - Common Work Results for HVAC.
  - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
  - 3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
  - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
  - 5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
  - 6. Section 23 05 14 - Variable Frequency Controllers.

#### **1.3 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Product Data, Submit the following:
  - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
  - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  - 3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
  5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

#### **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

#### **1.6 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

## 1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup is not acceptable.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "By Others". Extra materials shall be clearly labeled by unit name in protective container and delivered to CFISD for attic stock.
  - 1. Filters: Three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.
  - 2. **Refer to Part 2, 2.10 Air Filtration for Cy-Fair ISD standard acceptable filter sizes. Sizes other than listed will not be accepted.**

## 1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

## PART 2 – PRODUCTS

### 2.1 MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS  
23 73 13 - 3

1. Carrier
  2. JCI
  3. Trane
  4. Daikin
  5. Temtrol
  6. Thermal
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

## **2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION**

- A. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable.
- B. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control's contractor.

## **2.3 UNIT IDENTIFICATION REQUIREMENTS**

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Unit identification as indicated within Contract Documents.
  - Serial Number.
  - Model Number.
  - Capacity (CFM) and static pressure.
  - Motor Horsepower.
  - Unit Power Supply: Volts / PH / Amps.
  - Supply Fan Type.
  - Coil GPM and Pressure Drop.
  - Sales Order #.
  - Date of unit manufactured.

## **2.4 CASING**

- A. Full perimeter double-bottom steel base assembly constructed with a minimum of 12-gauge galvanized steel and shall be a minimum of six (6) inches in height. Base assembly shall be thermally broken and insulated with a minimum of 2" thick, R-13 closed-cell sprayed foam. Assemble multiple sections that are shipped loose with gaskets, caulk, and bolts per the manufacturer's installation instructions.
- B. Outside Casing:
1. Galvanized Steel: G90 with minimum 2" thick, foam filled insulation with thermal break. Minimum casing shall be R-13.

- C. Inside Casing:
  - 1. Galvanized Steel: G90; provide additional fiberglass insulated perforated panels in fan section and discharge plenum.
- D. Casing shall be supported by free-standing G90 structural frame with removable panels. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory. Top and side panels shall be easily removable for service.
- E. Insulation: Expanded Foam.
  - 1. 'K' (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.26 Btuh inch/ sq. ft./ degrees Fahrenheit.
  - 2. Density: Two (2) inch thick, minimum 3 lbs. / cu ft. density throughout the entire unit. One (1) inch thick casing panels in any section is unacceptable.
  - 3. Insulation in perforated sections shall be coated on air side to prevent erosion into air stream. Uncoated insulation is unacceptable.
  - 4. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.
- F. Access Section: 12" access section with double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier, and include a full perimeter automotive style gasket. All access doors shall match unit casing construction. Provide access sections with doors between parallel coil sections, upstream and downstream of each coil section, upstream and downstream of the energy recovery cores, in fan sections, filter sections, and mixing boxes. **Provide access doors on both sides of the unit for blower section, filter section and each side of drain pan unless unit is located directly against a wall.**
- G. Cooling Coil & Heating Coil Drain Pan: Double wall, Type 304 stainless steel IAQ pan with two (2) inch insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning from both sides.
- H. Strength and Leakage Integrity: Casing shall not exceed 0.0042-inch deflection per inch of panel span at 1.5 times the design static pressure up to a maximum of +8 inches in all positive pressure sections and -8 inches in all negative pressure sections. Units shall meet ASHRAE III Class 6 low leakage standard. Casing shall have less than a 1% leakage rate at +/- 8" W.G.

## 2.5 FACTORY FABRICATED MIXING BOXES

- A. Provide a factory fabricated mixing box section and outside air hood that matches the unit casing materials and insulation. Field fabricated mixing sections will not be accepted.

- B. Return Air & Outside Air Dampers: Class 1A leak rated damper assembly with extruded aluminum blades, synthetic bearings, ruskiprene blade edge seals, and compressible stainless-steel jamb seals equal to Ruskin CD50 series.
- C. Mixing sections shall have a double wall hinged access door on the drive side of the unit.
- D. Mixing boxes shall not be field fabricated.

## **2.6 FANS**

- A. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from welded aluminum.
- B. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.
- C. The Fan wheels shall be keyed to shaft to prevent slipping.
- D. Construction: AMCA Class II minimum.
- E. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
- F. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.
- G. Bearings: Provide permanently lubricated L-10, 200,000-hour bearings. Motors with bearing life less than specified, shall be provided with a five (5) year parts and labor warranty.
- H. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators with deflections in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment or 2" deflection, whichever requirement is stricter.
- I. Fan Modulation: Variable Frequency Drives.
- J. Fan Motors: All motors shall be premium efficiency, NEMA MG-1 Section 3, Inverter Duty, Totally Enclosed Fan Cooled (TEFC) or totally enclosed air over (TEAO). Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers. All motors smaller than 10 H.P., wire nuts are acceptable. All other motors 10 H.P. and larger shall be provided and installed with copper alloy split bolt connectors, insulated with rubber and electrical tapes; wire nuts are not acceptable. All motors connect to Variable Frequency Drive shall be equipped with carbon fiber shaft grounding rings.
- K. Flexible Connection: Provide internal flexible connection between fan and air unit casing. Flexible connection between air unit casing and connecting duct shall not be provided when fan is internally isolated with flexible connection to casing.
- L. Fan wheels and shafts shall be selected to operate at least 25% below the first critical speed and shall statically and dynamically balanced as an assembly.
- M. Electrically Commutated Motor (ECM) is also acceptable.

1. The fan section shall be provided with an externally mounted factory installed motor control panel in NEMA 1 enclosure.
2. Motor control panel shall include:
  - a. UL508a compliant control panel box.
  - b. Hand/off/auto switch.
  - c. Main disconnect switch.
  - d. Terminal block for fan speed control.
  - e. Individual motor protection.
  - f. Dial potentiometer.
3. Control panel shall not restrict access to fans or motors.

## 2.7 BEARINGS AND DRIVES

- A. Bearings: Pillow block type, self-aligning, regreasable (permanently lubricated not acceptable) ball bearings, with ABMA 9 L-10 life at 200,000 hours. Extend lubrication fittings to drive side of unit with plastic tube and fittings rigidly attached to casing.
- B. Shafts: Solid, hot rolled steel, ground and polished, with keyway, and protectively coated to prevent corrosion.
- C. Motor Shaft Grounding Kit: For all AHU motors connected to a Variable Frequency Drive, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.
- D. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg.
  1. Motor Enclosure: Totally Enclosed Fan-Cooled (TEFC) or Totally Enclosed Air-Over (TEAO).
  2. **All motors controlled by a Variable Frequency Drive shall be equipped with maintenance free microfiber shaft grounding ring. Provide Aegis SGR or prior owner approved equal.**
  3. **All motors smaller than 10 H.P., wire nuts are acceptable. All other motors 10 H.P. and larger shall be provided and installed with copper alloy split bolt connectors, insulated with rubber and electrical tapes. Wire nuts are not acceptable.**
  4. **Provide (2) two forged motor lifting eyes and oversized conduit boxes with ground lugs.**
  5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."



## 2.8 COILS

- A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank-offs and casing sealing grommets at connection penetrations. Cooling coils shall be supported by #304 stainless steel coil support members maintaining a minimum of 1" separation between bottom of coil casing and drain pan.
- B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- C. All coils shall be tested at 300 psig air pressure, under water.
- D. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal is not acceptable.
- E. Coils shall be drainable and have non-trapping circuits. Headers shall have drain and vent connections extended to the outside of the unit casing. Provide grommets at all pipe penetrations through cabinet.
- F. Water Heating Coils:
  - 1. Headers: Seamless copper tube with brazed joints, prime coated.
  - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
  - 3. 24-inch access section between parallel coil faces.
  - 4. Casing: Die formed channel frame of #304 stainless steel.
  - 5. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.025" copper.
  - 6. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.006" aluminum.
  - 7. Coil supports shall be 16-gauge #304 stainless steel.
  - 8. Coils with untreated outside air shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117-90. Field applied coatings will not be acceptable.
- G. Water Cooling Coils:
  - 1. Headers: Seamless copper tube with brazed joints, prime coated.
  - 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
  - 3. Coils shall be a maximum of six (6) rows deep.
  - 4. 24-inch access section between parallel coil faces.

5. Casing: Die formed channel frame of #304 stainless steel.
6. Drain Pans: Extend 24 inches downstream of coil and for coil banks more than 48 inches high provide intermediate #304 stainless steel pan with copper down spouts.
7. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.025" copper.
8. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.006" aluminum.
9. Coil supports shall be 16-gauge #304 stainless steel.
10. Tube Velocities: Coil tube design velocity shall be between 2 feet and 5 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained.
11. Coils with untreated outside air shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117-90. Field applied coatings will not be acceptable.

## 2.9 AIR FILTRATION

- A. Filter Box: Section with filter guides, access doors for side loading with gaskets and blank-off plates and shall include slide rails. Factory made filter racks only. Field altered racks are not acceptable.
- B. Custom made filter rack is acceptable with prior approval. Manufactured by Joe W. Fly Co., Inc.
- C. Filters: Maximum 2" thick, disposable pleated media type, 16 pleats per linear foot, MERV 13, or greater rating in accordance with ASHRAE Test Standard 52.2-2007.
- D. **Allowable filter sizes per Cy-Fair ISD standards: 16x20, 16x25, 20x20, and 20x25 only, no exceptions.**
- E. Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- F. Filter Area: Max velocity of 350 FPM.

## 2.10 CONTROLS

- A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

## 2.11 CAPACITY

- A. Performance: Provide equipment as scheduled on Drawings.

## **2.12 ELECTRICAL CHARACTERISTICS AND COMPONENTS**

- A. Electrical penetrations for conduits shall be made into the bottom only of electrical starters, VFD cabinets and control cabinets. Top or side cabinet penetrations will not be accepted.
- B. 10 HP and larger motors shall have split bolt connections or multi-tap screw connections; Insulate with rubber and electrical tape.
- C. Provide equipment with electrical characteristics as shown on Electrical Drawings.
- D. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.
- E. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.
- F. Combination Starter-Disconnect Switch: Provided by Division 26.
- G. Junction Box: Factory provided, mounted, and wired junction boxes on each fan section. J-box shall allow electrical contractor to connect power to device without penetrating through cabinet. Field installed J-boxes will not be acceptable; it shall be the complete responsibility of the manufacturer to install. Units shall be shipped with J-boxes pre-wired and mounted. Within equipment submittal the manufacturer shall show J-box location on plan view dimensional drawing.
- H. Combination Variable Frequency Drive-Disconnect Switch & Bypass: Air units that are scheduled to be controlled by a variable frequency drive shall be equipped with a factory provided variable frequency drives in a NEMA 1 enclosure. VFD shall be wall mounted and wired by mechanical contractor. Drives shall be in accordance with specification Section 23 05 14 - Variable Frequency Controllers. Drives shall be provided with Modbus, BACnet or LON Communications protocol as specified in Section 23 05 14 - Variable Frequency Controllers.
- I. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

## **2.13 SOURCE QUALITY CONTROL**

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install in accordance with ARI 430.
- B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases; Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.
- G. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.
- H. Installation of Hot Water Heating and/or Chilled Water Coil:
  - 1. Make connections to coils with unions. Position unions to permit coil removal.
  - 2. Connect water supply to leaving airside of coil (counter flow arrangement).
  - 3. Locate water supply at bottom of supply header and return water connection at top.
  - 4. Install water coils to allow draining and install drain connection at low points.
  - 5. Install the following piping accessories on piping connections. Refer to Section 23 05 19 – Meters and Gages for HVAC Piping.
    - a. On supply: (refer to coil connection details)
      - 1) Thermometer well and thermometer.
      - 2) Well for control system temperature sensor.
      - 3) Shutoff valve.
      - 4) Pressure gage.
      - 5) Y-Strainer
    - b. On return: (refer to coil connection details)
      - 1) Air vent.
      - 2) Thermometer well and thermometer.

- 3) Well for control system temperature sensor.
  - 4) Pressure gage.
  - 5) Modulating control valve.
  - 6) Flow control balancing valve.
  - 7) Shutoff valve.
6. Install valves and piping specialties in accordance with details as indicated on Drawings.
  7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
  8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.
- I. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short-circuited during operation.

### **3.2 CONNECTIONS**

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to air-handling unit to allow service and maintenance.
- D. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- E. Connect condensate drain pans using NPS 1-1/4, ASTM B 88, Type M (ASTM B 88M, Type C) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- F. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- G. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 23 31 13 "Metal Ducts" and Section 23 33 00 "Air Duct Accessories."
- H. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
  2. Charge refrigerant coils with refrigerant and test for leaks.
  3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

### 3.4 STARTUP SERVICE

- A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Verify that shipping, blocking, and bracing are removed.
  3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  6. Verify that zone dampers fully open and close for each zone.
  7. Verify that face-and-bypass dampers provide full face flow.
  8. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
  9. Comb coil fins for parallel orientation.
  10. Verify that proper thermal-overload protection is installed for electric coils.
  11. Install new, clean filters.
  12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

### **3.5 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### **3.6 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

### **3.7 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

### **3.8 PROTECTION OF FINISHED WORK**

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

**END OF SECTION 23 73 13**

## **SECTION 23 74 13.16 - OUTDOOR, CENTRAL-STATION HYDRONIC AIR HANDLING UNITS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes packaged, outdoor, central-station hydronic air-handling units with the following components and accessories such as but not limited to:
  - 1. Chilled water-cooling coil
  - 2. Hot water heating coil
  - 3. Roof curbs.
- B. Related Sections:
  - 1. Section 23 05 00 - Common Work Results for HVAC.
  - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
  - 3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
  - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
  - 5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
  - 6. Section 23 05 14 - Variable Frequency Controllers.

#### **1.3 SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Product Data, Submit the following:
  - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.



2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
  4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
  5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

#### **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

#### **1.6 QUALIFICATIONS**

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Equipment shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

#### 1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable.

#### 1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "By Others". Extra materials shall be clearly labeled by unit name in protective container and delivered to CFISD for attic stock.
  - 1. Filters: Three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.
  - 2. **Refer to Part 2, 2.10 Air Filtration for Cy-Fair ISD standard acceptable filter sizes. Sizes other than listed will not be accepted.**

#### 1.10 COORDINATION

- A. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

## **PART 2 – PRODUCTS**

### **2.1 OUTDOOR CENTRAL-STATION HYDRONIC AIR HANDLING UNITS**

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Carrier
  2. JCI
  3. Trane
  4. Daikin
  5. Temtrol
  6. Thermal
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

### **2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION**

- A. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable.
- B. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control's contractor.

### **2.3 UNIT IDENTIFICATION REQUIREMENTS**

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Unit identification as indicated within Contract Documents.
  - Serial Number.
  - Model Number.
  - Capacity (CFM) and static pressure.
  - Motor Horsepower.
  - Unit Power Supply: Volts / PH / Amps.
  - Supply Fan Type.
  - Coil GPM and Pressure Drop.
  - Sales Order #.
  - Date of unit manufactured.

### **2.4 CASING**

- A. Full perimeter welded double-bottom steel base assembly constructed with a minimum of 12-gauge galvanized steel and shall be a minimum of six (6) inches in height. Base assembly shall be thermally broken and insulated with a minimum of 2" thick, R-13

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closed-cell sprayed foam. Assemble multiple sections that are shipped loose with gaskets, caulk, and bolts per the manufacturer's installation instructions.

B. Exterior Casing:

1. Galvanized Steel: 20-gauge G90 expanded foam injected insulation.
2. Unit shall include exterior corrosion protection which shall be capable of withstanding at least 1,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

C. Interior Casing:

1. Galvanized Steel: Solid 20-gauge G90. Provide 20-gauge perforated panels in fan section and discharge plenum.

D. Roof:

1. Roof shall be double-wall, pitched in four directions at a minimum roof slope of 1/4-in. per foot across the width of the unit. No penetrations shall be made in pressure sensitive panels. Roof shall incorporate a standing top seam. All seams in the roof shall be gasketed and capped to prevent water infiltration into the unit.

E. Casing shall be supported by free-standing 16-gauge G90 structural frame with removable panels. Framing members shall have thermal break and injected with expanded foam insulation. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory with a minimum 1/4-inch-thick x 3/4 inch wide closed-cell neoprene. Top and side panels shall be easily removable for service.

F. Insulation: Glass fiber or Expanded Foam.

1. 'K' (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.154 Btuh inch / sq. ft. / degrees Fahrenheit.
2. Density: Two (2) inch thick, minimum 1-1/2 lbs. /cu ft. throughout the entire unit. One (1) inch thick casing panels in any section is unacceptable.
3. Insulation in perforated sections shall be coated on air side to prevent erosion into air stream. Uncoated insulation is unacceptable.
4. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.

G. Access Section: 24" access section with minimum 19" door clearance of double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier, and include a full perimeter automotive style gasket. All access doors shall match unit casing construction. Provide access sections with doors between parallel coil sections, upstream and downstream of each coil section, upstream and downstream of the energy recovery cores, in fan sections, filter sections, and mixing boxes. **Provide access doors on both sides of the unit for blower section and filter section unless unit is located directly against a wall.**

- H. Cooling Coil & Heating Coil Drain Pan: Double wall, Type 304 stainless steel IAQ pan with two (2) inch insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning.
- I. Strength and Leakage Integrity: Casing shall not exceed 0.0042-inch deflection per inch of panel span at 1.5 times the design static pressure up to a maximum of +8 inches in all positive pressure sections and -8 inches in all negative pressure sections. Units shall meet ASHRAE III Class 6 low leakage standard. Casing shall have less than a 1% leakage rate at +/- 8" W.G.

## **2.5 FACTORY FABRICATED MIXING BOXES**

- A. Provide a factory fabricated mixing box section and outside air hood that matches the unit casing materials and insulation. Field fabricated mixing sections will not be accepted.
- B. Return Air & Outside Air Dampers: Class 1A leak rated damper assembly with extruded aluminum blades, synthetic bearings, ruskiprene blade edge seals, and compressible stainless-steel jamb seals equal to Ruskin CD50 series.
- C. Mixing sections shall have a double wall hinged access door on the drive side of the unit.
- D. Mixing boxes shall not be field fabricated.

## **2.6 FANS**

- A. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from welded aluminum.
- B. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.
- C. The Fan wheels shall be keyed to shaft to prevent slipping.
- D. Construction: AMCA Class II minimum.
- E. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
- F. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.
- G. Bearings: Provide permanently lubricated L-10, 200,000-hour bearings. Motors with bearing life less than specified, shall be provided with a five (5) year parts and labor warranty.
- H. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators with deflections in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment or 2" deflection, whichever requirement is stricter.
- I. Fan Modulation: Variable Frequency Drives.

- J. Fan Motors: All motors shall be premium efficiency, NEMA MG-1 Section 3, Inverter Duty, Totally Enclosed Fan Cooled (TEFC) or totally enclosed air over (TEAO). Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers. All motors smaller than 10 H.P., wire nuts are acceptable. All other motors 10 H.P. and larger shall be provided and installed with copper alloy split bolt connectors, insulated with rubber and electrical tapes; wire nuts are not acceptable. All motors connect to Variable Frequency Drive shall be equipped with carbon fiber shaft grounding rings.
- K. Flexible Connection: Provide internal flexible connection between fan and air unit casing. Flexible connection between air unit casing and connecting duct shall not be provided when fan is internally isolated with flexible connection to casing.
- L. Fan wheels and shafts shall be selected to operate at least 25% below the first critical speed and shall statically and dynamically be balanced as an assembly.

## 2.7 BEARINGS AND DRIVES

- A. Bearings: Pillow block type, self-aligning, regreasable (permanently lubricated not acceptable) ball bearings, with ABMA 9 L-10 life at 200,000 hours. Extend lubrication fittings to drive side of unit with plastic tube and fittings rigidly attached to casing.
- B. Shafts: Solid, hot rolled steel, ground and polished, with keyway, and protectively coated to prevent corrosion.
- C. Motor Shaft Grounding Kit: For all AHU motors connected to a Variable Frequency Drive, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.
- D. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg.
  - 1. Motor Enclosure: Totally Enclosed Fan-Cooled (TEFC) or Totally Enclosed Air-Over (TEAO).
  - 2. **All motors controlled by a Variable Frequency Drive shall be equipped with maintenance free microfiber shaft grounding ring. Provide Aegis SGR or prior owner approved equal.**
  - 3. **All motors smaller than 10 H.P., wire nuts are acceptable. All other motors 10 H.P. and larger shall be provided and installed with copper alloy split bolt connectors, insulated with rubber and electrical tapes. Wire nuts are not acceptable.**
  - 4. **Provide (2) two forged motor lifting eyes and oversized conduit boxes with ground lugs.**
  - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 6. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

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## 2.8 COILS

- A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank-offs and casing sealing grommets at connection penetrations. Cooling coils shall be supported by #304 stainless steel coil support members maintaining a minimum of 1" separation between bottom of coil casing and drain pan.
- B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- C. All coils shall be tested at 300 psig air pressure, under water.
- D. All coils shall be installed on tracks for easy removal from the air handling unit. Units that require disassembly of the unit for coil removal is not acceptable.
- E. Coils shall be drainable and have non-trapping circuits. Headers shall have drain and vent connections extended to the outside of the unit casing. Provide grommets at all pipe penetrations through cabinet.
- F. Water Heating Coils:
  - 1. Headers: Seamless copper tube with brazed joints, prime coated.
  - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
  - 3. 24-inch access section between parallel coil faces.
  - 4. Casing: Die formed channel frame of #304 stainless steel.
  - 5. Drain Pans: Extend 24 inches downstream of coil and for coil banks more than 48 inches high provide intermediate #304 stainless steel pan with copper down spouts.
  - 6. Tubes: 1/2-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.025" copper.
  - 7. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.006" aluminum.
  - 8. Coil supports shall be 16-gauge #304 stainless steel.
  - 9. Coils with untreated outside air shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117-90. Field applied coatings will not be acceptable.
- G. Water Cooling Coils:
  - 1. Headers: Seamless copper tube with brazed joints, prime coated.
  - 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

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3. Coils shall be a maximum of six (6) rows deep.
  4. 24-inch access section between parallel coil faces.
  5. Casing: Die formed channel frame of #304 stainless steel.
  6. Drain Pans: Extend 24 inches downstream of coil and for coil banks more than 48 inches high provide intermediate #304 stainless steel pan with copper down spouts.
  7. Tubes: 1/2-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.025" copper.
  8. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.006" aluminum.
  9. Coil supports shall be 16-gauge #304 stainless steel.
  10. Coils with untreated outside air shall have a factory applied, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 3,000 hours salt spray per ASTM B117-90. Field applied coatings will not be acceptable.
- H. Tube Velocities: Coil tube design velocity shall be between 2 feet and 5 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained.

## 2.9 AIR FILTRATION

- A. Acceptable custom filter rack manufacturer:
  1. Joe W. fly Co.
- B. Filter Box: Section with filter guides, access doors for side loading with gaskets and blank-off plates.
- C. Filters: Maximum 2" thick, disposable pleated media type, 16 pleats per linear foot, MERV 13, or greater rating in accordance with ASHRAE Test Standard 52.2-2007.
- D. **Allowable filter sizes per Cy-Fair ISD standards: 16x20, 16x25, 20x20, and 20x25 only, no exceptions.**
- E. Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- F. Filter Area: Max velocity of 350 FPM.



## **2.10 INTAKE HOODS**

- A. Provide a factory fabricated outside air intake hood that matches the unit casing materials and insulation. Field fabricated intake hood sections will not be accepted.
- B. Dampers: Class 1A leak rated damper assembly with extruded aluminum blades, synthetic bearings, blade edge seals, and compressible stainless-steel jamb seals.

## **2.11 ROOF CURBS (SHALL BE PROVIDED BY ROOFTOP UNIT MANUFACTURER AND NOT "BY OTHERS"):**

- A. Roof Curb shall be constructed of G90 galvanized steel and designed to mate with the down flow (confirm arrangement with plans) supply and return openings and provide support and a watertight seal. Roof curb shall be insulated full perimeter welded and structurally calculated to meet wind requirements specified below. The roof curb design shall allow field-fabricated rectangular supply and return ductwork to be connected directly to the curb.
- B. All curbs shall be wind rated for a minimum of 155 miles per hour. Provide certified drawing signed and sealed by a professional engineer with equipment submittal; failure to do so will result in submittal rejection.
- C. Curb height shall be a minimum of 14".
- D. Match roof curb to roof slope to provide level surface for RTU mounting.
- E. All curbs shall be provided with minimum 14-gauge wind clips.
- F. Ship roof curb for field installation prior to unit placement.

## **2.12 CONTROLS**

- A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

## **2.13 CAPACITY**

- A. Performance: Provide equipment as scheduled on Drawings.

## **2.14 ELECTRICAL CHARACTERISTICS AND COMPONENTS**

- A. Electrical penetrations for conduits shall be made into the bottom only of electrical starters, VFD cabinets and control cabinets. Top or side cabinet penetrations will not be accepted.
- B. 10 HP and larger motors shall have split bolt connections or multi-tap screw connections; Insulate with rubber and electrical tape.
- C. Provide equipment with electrical characteristics as shown on Electrical Drawings.
- D. Convenience Outlet: A GFCI, 120v/15amp, 2 plug, unpowered. Convenience outlet connection shall be a separate electrical feed and not from the main.
- E. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.

- F. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.
- G. Combination Starter-Disconnect Switch: Provided by Division 26.
- H. Junction Box: Factory provided, mounted, and wired junction boxes on each fan section. J-box shall allow electrical contractor to connect power to device without penetrating through cabinet. Field installed J-boxes will not be acceptable; it shall be the complete responsibility of the manufacturer to install. Units shall be shipped with J-boxes pre-wired and mounted. Within equipment submittal the manufacturer shall show J-box location on plan view dimensional drawing.
- I. Motor Overload Panel: For units with more than one fan, and to allow for a connection to a single variable frequency drive, provide a factory mounted and wired motor overload panel. Panel shall be UL listed, NEMA 1 enclosure with IECC manual starters with rotary type operators and auxiliary contacts.
- J. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

## **2.15 SOURCE QUALITY CONTROL**

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install in accordance with ARI 430.

- B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- E. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.
- F. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.
- G. Installation of Hot Water Heating and/or Chilled Water Coil:
  - 1. Make connections to coils with unions. Position unions to permit coil removal.
  - 2. Connect water supply to leaving airside of coil (counter flow arrangement).
  - 3. Locate water supply at bottom of supply header and return water connection at top.
  - 4. Install water coils to allow draining and install drain connection at low points.
  - 5. Install the following piping accessories on piping connections. Refer to Section 23 21 13 - Hydronic Piping.
    - a. On supply: (refer to coil connection details)
      - 1. Thermometer well and thermometer.
      - 2. Well for control system temperature sensor.
      - 3. Shutoff valve.
      - 4. Pressure gage.
      - 5. Strainer
    - b. On return: (refer to coil connection details)
      - 1. Air vent.
      - 2. Thermometer well and thermometer.
      - 3. Well for control system temperature sensor.
      - 4. Pressure gage.
      - 5. Modulating control valve (by BAS).
      - 6. Victaulic / TA 78K (combination balancing / shut-off globe valve with memory stop and pressure / temperature ports).
      - 7. Shutoff valve (provided by mechanical contractor in addition to balancing valve).
  - 6. Install valves and piping specialties in accordance with details as indicated on Drawings.
  - 7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.

- 8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.
- H. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short-circuited during operation.

### **3.3 CONNECTIONS**

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to air-handling unit to allow service and maintenance.
- D. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- F. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 23 31 13 "Metal Ducts" and Section 23 33 00 "Air Duct Accessories."
- G. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

### **3.5 STARTUP SERVICE**

- A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Verify that shipping, blocking, and bracing are removed.
  3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  6. Verify that zone dampers fully open and close for each zone.
  7. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
  8. Comb coil fins for parallel orientation.
  9. Verify that proper thermal-overload protection is installed for electric coils.
  10. Install new, clean filters.
  11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
  2. Measure and record motor electrical values for voltage and amperage.
  3. Manually operate dampers from fully closed to fully open position and record fan performance.

### **3.6 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### **3.7 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean

fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

**3.8 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

**3.9 PROTECTION OF FINISHED WORK**

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. All air units shall remain in manufacturer's protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

**END OF SECTION 23 74 13.16**

## **SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS**

### **PART I -GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 GENERAL REQUIREMENTS**

- A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.
- B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).
- C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.
- D. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.
- E. Provide equipment with electrical characteristics as shown on the Electrical Drawings.
- F. All condensing unit mounted on the roof or wall must have stainless steel mount bracket. Refer to detail for additional information.

#### **1.3 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
  - a. Daikin
  - b. Trane / Mitsubishi
  - c. LG

#### **1.4 SUBMITTAL:**

- A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule, electrical characteristics and accessories being provided.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- D. Product Data: Submit product data, including manufacturer's  product sheet for specified

products.

### **1.5 WARRANTY**

- A. Five (5) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- B. Seven (7) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- C. Five (5) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

## **PART 2 –PRODUCTS**

### **2.1 UNIT CABINET:**

- A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Indoor and outdoor unit shall be of the same manufacturer.

### **2.2 COMPRESSOR**

- A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

### **2.3 COIL**

- A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
- B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

### **2.4 FANS**

- A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

### **2.5 AIR FILTERS**

DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS  
23 81 26 - 2



- A. Unit shall have filter track with factory-supplied cleanable filters.

## **2.6 CONTROLS:**

- A. Hardwired controller in space and sensor to monitor only through BAS.
- B. The unit shall have the following functions as a minimum:
  - 1. An automatic restart after power failure at the same operating conditions as at failure.
  - 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
  - 3. Temperature-sensing controls shall sense return air temperature.
  - 4. Indoor coil freeze protection.
  - 5. Automatic air sweep control to provide on or off activation of air sweep louvers.
  - 6. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
  - 7. Fan-only operation to provide room air circulation when no cooling is required.
  - 8. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
  - 9. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.

## **PART 3 -EXECUTION**

### **3.1 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
  - 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- B. If condensate pump is provided, place under the evaporator head in plain sight, not above ceiling.

### **3.2 STARTUP SERVICE**

- A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

### **3.3 CLEANING**

- A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

**END OF SECTION 23 81 26**

## **SECTION 23 82 39.19 - ELECTRIC UNIT HEATERS**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Electric Unit Heaters.
- B. Related Sections:
  - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
  - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

#### **1.3 REFERENCES**

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
  - 2. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.
- B. Underwriters Laboratories Inc.:
  - 1. Units to be UL Listed.

#### **1.4 ACTION SUBMITTALS**

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Plans, elevations, sections, and details.
  - 2. Location and size of each field connection.
  - 3. Details of anchorages and attachments to structure and to supported equipment.

4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of integral controls.
6. Wiring Diagrams: Power, signal, and control wiring.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  1. Suspended ceiling components.
  2. Structural members to which unit heaters will be attached.
  3. Method of attaching hangers to building structure.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Air outlets and inlets.
    - b. Speakers.
    - c. Sprinklers.
    - d. Access panels.
  6. Lighting fixtures.
  7. Perimeter moldings for exposed or partially exposed cabinets.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

### **1.7 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Accept heaters and controls on site in factory packaging. Inspect for damage.

## 1.9 WARRANTY

- A. Furnish a five (5) year manufacturer warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start-up will not be acceptable.

## PART 2 - PRODUCTS

### 2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
  - 1. Reznor
  - 2. Markel
  - 3. Qmark
- B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, controls, and accessories complying with ARI 440:
  - 1. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
  - 2. Control Voltage: 24-volt, 60 hertz
  - 3. Wall mounted adjustable thermostat.
  - 4. Location: Suspended overhead.
  - 5. Comply with UL 2021.
- C. Cabinet: 18-gauge steel with baked enamel finish, easily removed and secured access panels, insulated or double panel construction.
- D. Supply Fan: Propeller type with direct drive, dynamically balanced and mounted with rubber vibration insulators.
- E. Heat Exchanger: High mass, all steel tubular finned type, copper brazed elements.
- F. Controls: Wall mounted Thermostat with fan switch.
- G. Motor: Totally enclosed industrial rated. Motor on units to 20KW shall utilize sealed bearings. Motor on units larger than 20KW shall be 2-speed, permanent capacitor-type, continuous duty.
- H. Wiring:
  - 1. Sub-divided circuits with individual fuse protection
  - 2. Internal 24V control transformer.
  - 3. Heavy duty magnetic contactors.
  - 4. Thermal cutouts on control circuit with automatic reset.

5. Low voltage thermostatic kit with fan switch.
6. Factory wired disconnect switch.
  
7. Performance: Provide equipment as scheduled on Drawings.

### **PART 3 – EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

#### **3.3 CONNECTIONS**

- A. Comply with safety requirements in UL 1995.

#### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

#### **3.5 ADJUSTING**

- A. Adjust initial temperature set points.

**3.6 DEMONSTRATION**

- A.** Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

**END OF SECTION 23 82 39.19**

## SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of ten (10) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
  - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
  - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
  - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.



4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
  3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  4. Waives claims for additional costs or time extension which may subsequently become apparent.
  5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

### 1.3 SUMMARY

- A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

### 1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the national electrical code, and local codes.
- B. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

### 1.5 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.
- C. Make all electrical connections to all equipment furnished by this division and any other division.

- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

## **1.6 DRAWINGS**

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.
- B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

## **1.7 SUBMITTALS**

- A. Specification Review:
  - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

## **1.8 DELIVERY, STORAGE, HANDLING AND PRODUCT**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.
- D. Provide allowance in bid for ten lighting control switching circuit drops of thirty feet in length for miscellaneous needs during construction. Include one 277V light switch per

circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.

- E. Provide allowance in bid for ten additional exit signs for miscellaneous needs during construction. Include circuiting, all associated labor and all necessary accessories required for proper installation

## **PART 2 - EXECUTION**

### **2.1 OWNER INSTRUCTION**

- A. Provide on-site Owner training for all new equipment.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

**END OF SECTION 26 05 00**

## **SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide a complete system of building wire and cable to all electrical loads.

#### **1.3 SYSTEM DESCRIPTION**

- A. Product Requirements: Provide products as follows:
  - 1. Provide stranded conductors for all wiring.
  - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
  - 3. Conductor not smaller than 16 AWG for control circuits.
  - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
  - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
  - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
  - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN-2 insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.
- D. All cables not installed in conduit shall be plenum rated.
- E. All conductors and cables shall be properly labeled at both ends of the installations and at any splice location.
- F. All low voltage system cables shall be continuous; splices are not accepted.
- G. All low voltage cables installed in open ceilings shall be installed in conduit.
- H. All cables and wire ran in plenum spaces shall be plenum rated.
- I. All plenum rated cable not installed in conduit shall be supported by nylon straps or D-rings.
- J. Do not allow cable systems to be supported from structural bridging.
- K. All wiring shall be ran parallel or perpendicular to the building structure unless authorization for isolated installations has been given to the consultant by a CFISD PM prior to proceeding with the installation.

- L. All cables shall be properly tested, documented and results turned over prior to CFISD acceptance.
- M. All Plenum rated cables penetrating masonry construction shall be sleeved.
- N. All non-plenum rated cable discovered during project design/renovation shall be removed / replaced or well documented for future consideration of removal. Consult with CFISD for desired method once discovered.
- O. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
- P. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors and equipment ground conductors in any raceway shall not exceed seven.
- Q. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
- R. When more than four (4) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
- S. All AHU motors to have split bolt connectors. All other motors 10 H.P. and larger shall be provided and installed with split bolt connectors. Wire nuts are not acceptable.
- T. All circuit conductors shall be the same color from breaker to outlet or equipment.

#### **1.4 COORDINATION**

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

### **PART 2 - PRODUCTS**

#### **2.1 BUILDING WIRE**

- A. Manufacturers:
  - 1. Diamond Wire & Cable Co.
  - 2. Southwire
  - 3. General Cable Co.
  - 4. IUSA Wire
  - 5. Encore
- B. Product Description: Single conductor insulated wire.
- C. Conductor: All conductors shall be copper; aluminum is not acceptable.
- D. Minimum branch circuit / feeder conductor size shall be #12 stranded copper.
- E. Minimum low voltage system wiring size - see Low Voltage and Mechanical Standards Section

- F. All products assembled in the United States of America.
- G. All products shall be U.L. listed.
- H. All low voltage cabling shall be plenum rated.
- I. Insulation: NFPA 70; Type THHN/THWN-2 insulation for feeders and branch circuits.

## **2.2 TYPE AC CABLE**

- A. Manufacturers:
  - 1. AFC
  - 2. Southwire
- B. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.
- C. Comply with NEC 320.
- D. Support, provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.
- E. Provide an insulated green grounding conductor in all Type AC cable.
- F. Acceptable Use: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.
- G. Provide insulated throat fittings at all terminations of Type AC cable.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

### **3.2 INSTALLATION**

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques - Wiring Connections:
  - 1. Clean conductor surfaces before installing lugs and connectors.
  - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
    - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and

- or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
- b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
  - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
  4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
  5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
  6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
  7. All work to be performed by a licensed journeyman technician

### 3.3 WIRE COLOR

#### A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

<u>System/Phase</u>	<b>Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)</b>				<b>Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)</b>	
	<b>A</b>	<b>B</b>	<b>C</b>	<b>N</b>	<b>G</b>	<b>IG</b>
120/208 3Ø	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3Ø	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1Ø	Black	Blue		White	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.
2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.

3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:  
For 6 AWG and smaller: Green.  
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

### **3.4 GROUPING OF CIRCUITS**

- A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping of different voltages is not allowed.
- C. Provide metal box sizes per NEC Table 314.16 (A).
- D. Provide conduit per NEC Annex C.
- E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

### **3.5 POWER LIMITED CIRCUIT INSTALLATION**

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed exposes in finished spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other "hard" (non-lay-in) ceiling types of construction.
- C. Labeling: Provide label on all junction boxes.
  1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

**END OF SECTION 26 05 19**



## **SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

#### **1.3 REFERENCES**

- A. Institute of Electrical and Electronics Engineers:
  - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
  - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. NFPA 70 - National Electrical Code.

#### **1.4 SYSTEM DESCRIPTION**

- A. Grounding systems use the following elements as grounding electrodes:
  - 1. Metal underground water pipe.
  - 2. Metal building frame.
  - 3. Concrete-encased electrode.
  - 4. Rod electrode.
  - 5. Plate electrode.

#### **1.5 SUBMITTALS**

- A. Product Data: Submit data on grounding electrodes and connections.

#### **1.6 QUALITY ASSURANCE**

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

#### **1.7 EXOTHERMIC CONNECTIONS**

- A. Manufacturers:
  - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

## **GROUNDING BUSSES**

- A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
  - 1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
  - 2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
  - 3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
  - 4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
  - 5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
  - 6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Series two (2) inch insulators.
  - 7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
  - 8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, [www.harger.com](http://www.harger.com)), Erico, Inc. (800-248-9353) or approved equal.

### **1.8 DRIVEN ELECTRODE ACCESS WELL AND COVER**

- A. Eight (12) inch diameter concrete pipe with belled end.
- B. 24 inches long or longer to reach ground and set flush in grade.
- C. Provide cast iron cover with "GROUND" embossed on top.

## **PART 2 – EXECUTION**

### **2.1 EXAMINATION**

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

### **2.2 PREPARATION**

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

### **2.3 INSTALLATION**

- A. Install in accordance with NEC Article 250 Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment..
- B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
- C. Install grounding and bonding conductors concealed from view.

- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.
- E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- F. Transformers: Ground as a separately derived source.
  - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
  - 2. Size bonding jumper per NEC Table 250.66.
  - 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system. Bond each end of raceway per NEC.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Concrete-Encased Electrode (NEC 250-52):
  - 1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless other wise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.
- I. Made Electrode:
  - 1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
  - 2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
  - 3. Install grounding electrode conductor of 3/0 Copper.
- J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- K. Grounding Busses:
  - 1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
  - 2. Provide in each IDF and MDF room.
  - 3. Provide at each CATV / MATV head-end mounting board.
  - 4. Provide at each building communications rack.
  - 5. Provide at each sound reinforcement equipment rack.
- L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- M. Metal Building Frame NEC 250-52.

1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
  2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.
- N. Fuel Gas Piping:
1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
  2. Gas piping shall not be used as a grounding electrode.
- O. Engine Generator Neutral:
1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
  2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.
- P. Outdoor Lighting Poles:
1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

### 3.5 OTHER GROUNDING SYSTEMS:

- A. General Check the drawings for special grounding system or grounding requirements.
- B. Telephone and data equipment grounding connections:
1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.
- C. Other Buildings Served From Common Service:
1. The main building service is the source for electric service to several out buildings on site.
  2. Isolate neutral bus from ground at each out-building main panel.
  3. Provide an equipment grounding conductor in feeder to each out-building main panel.
  4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
  5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

### 3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.

- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, install grounding bushing comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

### **3.7 FIELD QUALITY CONTROL**

- A. Grounding Tests:
  - 1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
  - 2. Provide written test report to document all findings, test values, work done and certification of grounding system.
  - 3. Use true-RMS meters for all voltage and current measurements.
  - 4. Test telecommunications grounding riser to verify continuity.
  - 5. Check all isolated ground receptacles for correct polarity.
  - 6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
  - 7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
  - 8. Verify continuity and isolation of audio system ground bus and grounding riser.
  - 9. Perform ground resistance and continuity testing in accordance with IEEE 142.
  - 10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest

### **3.8 TEST WELLS**

- A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
  - 1. Designated Ground Rods:
    - a. One (1) at triple ground rod for Elementary Main Switchboard Electrical Room.
    - b. One (1) at each generator.

**END OF SECTION 26 05 26**

## **SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  1. Conduit supports.
  2. Formed steel channel.
  3. Spring steel clips.
  4. Sleeves.
  5. Mechanical sleeve seals.
  6. Firestopping relating to electrical work.
  7. Firestopping accessories.
  8. Equipment bases and supports.

#### **1.3 REFERENCES**

- A. Underwriters Laboratories Inc.:
  1. UL 263 - Fire Tests of Building Construction and Materials.
  2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
  3. UL 1479 - Fire Tests of Through-Penetration Firestops.
  4. UL - Fire Resistance Directory.

#### **1.4 DEFINITIONS**

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

#### **1.6 SUBMITTALS**

- A. Product Data:
  1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

#### **1.7 QUALITY ASSURANCE**

- A. Perform Work in accordance with the Building Code.

## **PART 2 - PRODUCTS**

### **2.1 CONDUIT SUPPORTS**

- A. Manufacturers:
  - 1. Allied Tube & Conduit Corp.
  - 2. Electroline Manufacturing Company
  - 3. O-Z Gedney Co.
  - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

### **2.2 FORMED STEEL CHANNEL**

- A. Manufacturers:
  - 1. Allied Tube & Conduit Corp.
  - 2. B-Line Systems
  - 3. Midland Ross Corporation, Electrical Products Division
  - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

### **2.3 SLEEVES**

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

### **2.4 SPRING STEEL CLIPS**

- A. Product Description: Mounting clamp, and screw.

### **2.5 MECHANICAL SLEEVE SEALS**

- A. Manufacturers:
  - 1. Thunderline Link-Seal, Inc.
  - 2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## **2.6 FIRESTOPPING**

- A. Manufacturers:
  - 1. Dow Corning Corp.
  - 2. Fire Trak Corp.
  - 3. Hilti Corp.
  - 4. International Protective Coating Corp.
  - 5. 3M fire Protection Products .
  - 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
  - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
  - 2. Foam Firestopping Compounds: Multiple component foam compound.
  - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
  - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
  - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
  - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
  - 7. Firestop Pillows: Formed mineral fiber pillows.

## **2.7 FIRESTOPPING ACCESSORIES**

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
  - 1. Furnish UL Listed products.
  - 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
  - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
  - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.



### 3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
  - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
  - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
  - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
  - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
  - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
  - 6. Sheet Metal: Provide sheet metal screws.
  - 7. Wood Elements: Provide wood screws.
  
- B. Inserts:
  - 1. Install inserts for placement in concrete forms.
  - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
  
- C. Install conduit and raceway support and spacing in accordance with NEC.
  
- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.
  
- E. Install multiple conduit runs on common hangers.
  
- F. Supports:
  - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
  - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
  - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
  - 4. Support vertical conduit at every floor.

### 3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
  
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
  
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
  
- D. Compress fibered material to maximum 40 percent of its uncompressed size.

- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
  - 1. Seal opening at all rated floors and walls as follows:
    - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Pack void with backing material.
    - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
  - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
  - 1. Seal opening through non-fire rated floors and walls as follows:
    - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
    - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
    - c. Install type of firestopping material recommended by manufacturer.
  - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
  - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

### **3.4 INSTALLATION - SLEEVES**

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

**END OF SECTION 26 05 29**

## **SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.1 SUMMARY**

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

#### **1.2 REFERENCES**

- A. American National Standards Institute:
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
  - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
  - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

#### **1.3 SYSTEM DESCRIPTION**

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.
- F. Provide electrical raceways and fittings for all types of electrical conductors unless plenum rated and wiring is specified for low voltage systems, then raceways will only be required in areas not accessible (Ex. Above hard ceilings, inside or through all walls). Install low voltage cable in raceway in all open ceiling mechanical rooms.
- G. No conduits run in building slab. Under slab branch circuits is prohibited, except for floor receptacles and central plant equipment
- H. Light fixture whips shall be ½-inch flexible metal conduit or 3/8-inch steel MC cable, and shall not exceed 6'-0" in length.
- I. Conduit for roof-mounted equipment shall be routed through the roof curb assembly. Show installation in design details. Provide lock-off provision at panel to remove all power inside equipment route thru roof curb and roof equipment.
- J. Provide insulated throat connectors (steel fittings only); shall include low voltage cable drops and all conduits.
- K. Provide grounding bushing where concentric and/or eccentric connections or reducing washers are used.
- L. Liquid tight flexible metal conduit in damp or wet locations shall be used for all motor, transformer, and equipment connections only, no substitutes. Flexible conduit shall be minimum 18-inches and not exceed 24-inches in length.
- M. Flexible metallic conduit shall be used for all other motor, transformer, and equipment locations and shall be minimum 18-inches and not exceed 24-inches
- N. Within 50'-0" of cooling towers and swimming pools, provide PVC coated rigid conduit and fittings.
- O. All boxes located above the ceiling shall be located a maximum of 18" above the scheduled ceiling grid installation.
- P. All exterior boxes located in the ground shall be concrete with traffic rated tops.
- Q. Provide empty conduit from distribution panel consisting of two 2" with pull strings, and a junction box installed above the ceiling to a location determined during design for future portable buildings. Coordinate with CFISD. Provide j-box for LV and EL.
- R. Electrical raceways located within 100'-0" of water sources, such as cooling towers, shall be PVC coated RGS, or RTRC fiberglass conduit.
- S. All underground distribution feeders shall be installed in schedule 80 PVC conduit with grounding conductor sized per NEC. 90° elbows shall be rigid galvanized steel and stub ups through concrete floor to be PVC coated rigid galvanized steel to the bottom of the distribution panel board. All change in directions shall use long sweep radius ells. All underground/under slab shall be installed 48 inches below finish floor and marked with red tracer tape.
- T. No underground branch circuits EXCEPT from nearest structural column or load bearing wall in direction of panel serving load, closet wall in room to floor box receptacles.

- U. All branch circuits to service the needs within the building shall be installed above slab and supported from the structure. Install all above grade raceways parallel and perpendicular to building.
- V. All buried electrical conduits other than secondary electrical service shall be installed 12" under a building slab, covered with caution plastic tracer tape before backfill. NEC depth below building is zero inches, specify a burial depth under building finished floor.
- W. All surface mounted raceways shall be wire mold type mechanically fasted to wall. Surface raceway shall be similar Legrand Wiremold to v500 and v700 types, depth and width shall be sized accordingly to type of wiring/cablings and number of conductors/cables
- X. All underground feeders shall be schedule 80 PVC, with RGS 90s.

#### **1.4 DESIGN REQUIREMENTS**

- A. Minimum Raceway Size: 3/4 inch.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.
- C. Store all materials in a dry location protected from damage and dirt.

#### **1.6 COORDINATION**

- A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.
- B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.
- C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.
- D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

### **PART 2 - PRODUCTS**

#### **2.1 METAL CONDUIT**

- A. Manufacturers:
  - 1. Carlon Electrical Products
  - 2. Hubbell Wiring Devices
  - 3. Thomas & Betts Corp
  - 4. Walker Systems Inc.
  - 5. The Wiremold Co.

6. Multi Cell
  7. O-Z Gedney
  8. Raco.
  9. or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit
- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.
- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.
- H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
1. Manufacturer:
    - a. Ocal Inc.
    - b. Perma Cote Industries
    - c. Rob-Roy Industries
    - d. or Approved equal.
- I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.
- J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
  2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

## 2.2 ENCLOSURES

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.

- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
  - 1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
  - 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
  - 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
  - 4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. "Quazite" or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

## 2.2 WIREWAY

- A. Manufacturers: Same as Metal Conduit.
- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

## 2.3 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
  - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
  - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.
- E. All boxes shall be color coded as follows.
  - 1. 120 v / 208 v - Green UL.
  - 2. 240 v - Blue

3. 277 v / 480 v – Orange
4. HVAC controls – Yellow
5. Fire Alarm – Red
6. Emergency – Red

## 2.4 FLOOR BOXES

- A. UL listed for wet application, watertight cast-iron, scrub-shield compliant.
- B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
  7. Floor: Fully adjustable before and after pour.
  8. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
  9. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
  10. Multi Gang Floor Box: Fully adjustable watertight cast iron gang floor boxes where shown on Drawings. Provide with removable partition and provide conduit openings in boxes as required. Install power circuits in separate raceway from data, telephone or other signal.
- C. Manufacturers:
  1. Appleton
  2. Carlon
  3. Crouse-Hinds
  4. Hubbell
  5. FSR
  6. Wiremold/Legrand

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

### 3.2 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.



- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.
- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.
- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.
- U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.
- V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- AA. Close ends and unused openings in wireway.
- BB. Provide tracer wire on all underground raceway outside building slab on grade.
- CC. c

- DD. Electrical raceways located within 100'-0" of water sources, such as cooling towers, shall be PVC coated RGS.

### 3.3 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
1. Under Slab on Grade: Schedule 40 PVC.
  2. Outdoor Locations, Above Grade: Rigid galvanized steel.
  3. Wet and Damp Locations: Rigid galvanized steel.
  4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
  5. Underground:
    - a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs, parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
    - b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6" above raceway.
  6. Transformers and Motors: 24 inch maximum flexible metal conduit to equipment.
  7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.
  8. Cooling Towers: PVC coated rigid galvanized steel within 100 feet of tower.

### 3.4 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.
- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.
- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.

- K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.
- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.
- N. All boxes shall be labeled with each circuit and relay number if applicable on the cover and visible from outside of the box.
- O.

### **3.5 ADJUSTING**

- A. Install knockout closures in unused openings in boxes.

### **3.6 CLEANING**

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

### **3.7 INSTALLATION - FLOOR BOXES**

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.
- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

### **3.8 ADJUSTING**

- A. Adjust floor box flush with finish material.

### **3.9 CLEANING**

- A. Clean interior of boxes to remove dust, debris, and other material.

### **3.11 ABOVE CEILING JUNCTION BOXES**

- A. Labeling: Provide label on all above ceiling junction boxes.
  - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

**END OF SECTION 26 05 33**

## SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Nameplates.
  - 2. Underground Warning Tape.
  - 3. Lockout Devices.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
  - 1. National Electrical Code, NFPA No. 70.
  - 2. NEMA standards applicable to the product provided.
  - 3. UL standards applicable to the product provided.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Panduit Corp.
  - 2. American Labelmark Co.
  - 3. Markal Corp.
  - 4. Calpico, Inc.
  - 5. Ideal Industries, Inc.

#### 2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:
  - 1. 1/4 inch high letters for identifying individual equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.

## 2.3 UNDERGROUND WARNING TAPE

- A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
  2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
  3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
  4. Secure nameplate to equipment front using screws, rivets, or adhesive.
  5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
  6. Install nameplates for the following:
    - a. Switchboards
    - b. Panelboards
    - c. Transformers
    - d. Service Disconnects
      - 1) Enclosed Switches
    - e. Motor Control Centers
    - f. Stand-alone Motor Controllers
    - g. Generators
    - h. Contactors
- C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
  2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:
1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
  2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
  3. Copy in Owner's Manual.

### **3.3 ABOVE CEILING JUNCTION BOXES**

- A. Labeling: Provide label on all above ceiling junction boxes.
  - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

### **3.4 ARC FLASH WARNING LABEL**

- A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

**END OF SECTION 26 05 53**

## **26 08 00 – ELECTRICAL AND LIFE SAFETY SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS**

### **PART 1 – GENERAL**

#### **1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

#### **1.2. SUMMARY**

- A. The purpose of this Section is to define responsibilities in the Commissioning Process. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, “Recommended Practice for Commissioning Building Electrical Systems”, 27<sup>th</sup> Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning Requirements are provided separately, and coordination is detailed in Division 01. Division 26 and 28 Contractors shall be familiar with all parts of Division 01, the General Commissioning Requirements and the Commissioning Plan issued by the Owner’s CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. Electrical Testing Agency (ETA)
  - 1. The Contractor shall retain an independent Electrical Testing Agency (ETA). Their specific testing responsibilities are delineated in individual technical sections within Division 26. This generally requires checking and testing of the electrical power distribution equipment per National Electrical Testing Association (NETA) Acceptance Testing Standards (ATS).
  - 2. Attend, as needed, Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor, Owner or CxA to facilitate the Commissioning process.
  - 3. Obtain all required manufacturer’s data to facilitate tests.
  - 4. Provide assistance to the CxA in preparation of the specific System Verification Checklists (SVC) and Functional Performance Test procedures.
  - 5. Generally, the ETA shall provide their standard forms to document the NETA tests to be incorporated into the System Verification Checklists and Functional Performance Test records.
  - 6. The ETA shall assist the Contractor in completing required SVC information such as relay settings, protective overload settings, and equipment ratings utilizing the protocols in the Commissioning Plan.
  - 7. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a copy to the Contractor.
  - 8. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking. The field technicians shall keep a running log of events and issues.
  - 9. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
- D. Electrical systems to be commissioned include the following:

1. Unit Substations / Electrical Switchboards
2. Secondary Normal Power Distribution
3. Emergency / Standby Power Distribution
4. Branch Power Distribution and Components
5. Emergency Generators and Paralleling Switchgear
6. Uninterruptible Power Supplies (UPS)
7. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)
8. Lighting - Daylight Controls (100%)
9. Lighting - Time Switch Controls (100%)

### 1.3. DEFINITIONS

- A. Refer to Division 01: General Commissioning Requirements for definitions.

### 1.4. SUBMITTALS

- A. Contractor shall provide Owner and / or CxA with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.
  1. Shop drawings and product submittal data related to systems or equipment to be commissioned.
- B. Contractor shall submit to Owner and / or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- C. Where installation testing may be performed in a progressive manner (ie. grounding systems, insulation resistance, etc.), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be performed, documented and presented for approval prior to the start of any testing activities.
- D. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- E. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process
  1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
  2. Incorporate manufacturer's initial energizing / startup procedures with System Verification Checklists.
  3. Final Electrical Testing Agency (ETA) Reports documenting all NETA requirements indicated in the Project Documents
  4. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
  5. Operating and Maintenance (O&M) information per the requirements of the Technical Specifications and Division 01 requirements.



## **PART 2 - PRODUCTS**

### **2.1. GENERAL**

- A. All materials and installation shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- C. Contractor is required to follow all applicable industry and site specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

### **2.2. TEST EQUIPMENT**

- A. The Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

## **PART 3- EXECUTION**

### **3.1. CONSTRUCTION PHASE**

- A. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- B. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.
- C. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- D. Provide additional requested documentation to the Owner and / or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
  - 1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
  - 2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and / or CxA.
  - 3. This information and data request may be made prior to normal submittals.

- E. With input from the Lighting Controls, PCMS vendors and A/E, clarify the operation and control of commissioned equipment in areas where the Specifications, control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
- F. During the installation, Start-up and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- G. **Factory Start-ups:** Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
- H. **Independent Testing Agencies:** For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.
- I. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
- J. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
- K. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).
- L. Provide training of the Owner's operating personnel as specified.
- M. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

### **3.2. WARRANTY PHASE**

- A. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.
  - 1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.
- B. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.

### **3.3. INSTALLATION**

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

- B. All installation shall be in accordance with the Project Documents.

**3.4. TRAINING**

- A. Refer to the individual section of this Specification for specific training requirements on each system.
  - 1. Refer to the General Commissioning Requirements and Division 01 of the Project Specifications for overall training requirements related to the Commissioning process and this project.

**END OF SECTION 26 08 00**

## **SECTION 26 09 23 - LIGHTING CONTROL DEVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

#### **1.3 SUBMITTALS**

- A. Product Data: Submit dimensions, size, voltage ratings and current ratings.
- B. Short circuit current rating (SCCR) of equipment.
- C. U.L. Label.
- D. Electrical characteristics of equipment.
- E. Enclosure metal gauge and finish.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Provide manuals as described in Section 26 05 00.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL PURPOSE CONTACTORS**

- A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.
- B. Manufacturers:
  - 1. ASCO
  - 2. Square D
  - 3. GE
- C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.
- D. Lighting Contactors:
  - 1. Mechanically held, electrically operated.
  - 2. ASCO 918 or approved equal.
  - 3. Provide ASCO Accessory 47 for two-wire control of contactor. All contactor shall be controlled via BAS.

4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
  5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
  6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.
  7. Contactors for lighting control shall be minimum 30A rated with 120V coil.
- E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

#### **DIGITAL TIME SWITCHES:**

- F. Recessed in wall: Wattstopper TS-400 or approved equal.
1. The digital time switch shall be programmable to turn lights off after a preset time.
  2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.
  3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
  4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
  5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
  6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
  7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
  8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
  9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
  10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
  11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
  12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.

13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".
- B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.
- C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

**END OF SECTION 26 09 23**

## **SECTION 26 09 43 - DIGITAL LIGHTING CONTROLS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Distributed Digital Lighting Control System: System includes
  - 1. Digital Lighting Controls
  - 2. Relay Panels
  - 3. Emergency Lighting Control.

#### **1.2 RELATED SECTIONS**

- A. Section 27 05 39 - Surface Raceways for Communications Systems
- B. Section 26 50 00 - Lighting.
- C. Section 26 52 00 - Emergency Lighting.
- D. Section 25 55 00 - Integrated Automation Control of HVAC- Integrated Automation, Building integrator shall provide integration of the lighting control system with Building Automation Systems.

#### **1.3 REFERENCES**

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.
- B. NEMA - National Electrical Manufacturers Association
- C. FCC emission standards
- D. UL - Underwriters Laboratories, Inc. Listings
- E. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.
- F. UL 20 - General Use Switches, Plug Load Controls
- G. UL 924 - Standard for Emergency Lighting and Power Equipment
- H. ULC - Underwriter Laboratories of Canada Listings

#### **1.4 DESIGN / PERFORMANCE REQUIREMENTS**

- A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.
- B. System shall conform to requirements of NFPA 70.
- C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.
- D. System shall be listed under UL sections 916 and/or 508.

#### **1.5 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Catalog sheets and specifications.
  - 2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation instructions.
- C. Shop Drawings: Wiring diagrams a for the various components of the System specified including:
  - 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
  - 2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.
  - 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
  - 4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Closeout Submittals:
  - 1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
  - 2. Operation and Maintenance Manual:
    - a. Include approved Shop Drawings and Product Data.
    - b. Include Sequence of Operation, identifying operation for each room or space.
    - c. Include manufacturer's maintenance information.
    - d. Operation and Maintenance Data: Include detailed information on device programming and setup.
    - e. Include startup and test reports.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.
- B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of networked lighting control products with minimum three years documented experience.
- C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.
- B. Review installation procedures and coordination required with related Work and the following:
  - 1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
  - 2. Review the specifications for low voltage control wiring and termination.
  - 3. Discuss the functionality and configuration of all products, including sequences of



operation, per design requirements.

4. Discuss requirements for integration with other trades
- C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
  2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
  3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.
- B. Include 5% of hardware as attic stock.

#### 1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
  2. Relative humidity: Maximum 90 percent, non-condensing.

#### 1.10 WARRANTY

- A. Products Warranty: Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Legrand: Wattstopper DLM,
- B. Substitutions: Not permitted.

#### 2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

- A. System General: Provide a WattStopper, Provide Digital Lighting Management System (DLM) complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the Architect for clarification prior to proceeding.
  1. Daylit Areas: Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
    - a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
    - b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
    - c. Multiple-level switched daylight harvesting controls may be utilized for areas

- marked on drawings.
- d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.
- B. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.
1. Digital Lighting Management (DLM) local network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
  2. Digital Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
  3. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
  4. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
  5. Handheld remotes for personal control: On/Off, dimming and scene remotes for control using infrared (IR) communications. Remote may be configured in the field to control selected loads or scenes without special tools.
  6. Digital Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
  7. Configuration Tools: Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.
  8. Programming and Configuration Software: Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
  9. Digital Lighting Management Relay Panel and Zone Controller: Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS). Zero relay Zone Controller primarily supports Digital Fixture Controller applications.
  10. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building
- C. Local Network LMRJ-Series: DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
1. Features of the DLM local network include:
    - a. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
    - b. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
    - c. Push n' Learn configuration to change the automatic configuration, including

- binding and load parameters without tools, using only the buttons on the digital devices in the local network.
- d. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
2. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
  3. If manufacturer's pre-terminated Cat5e cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.

### 2.3 DIGITAL LOAD CONTROLLERS (ROOM, AND FIXTURE CONTROLLERS)

- A. Digital Load Controllers: Digital controllers for lighting zones, fixtures automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features
  1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
  2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
  3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.
  4. Device Status LEDs to indicate:
    - a. Data transmission
    - b. Device has power
    - c. Status for each load
    - d. Configuration status
  5. Quick installation features including:
    - a. Standard junction box mounting
    - b. Quick low voltage connections using standard RJ-45 patch cable
  6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
    - a. Turn on to 100 percent
    - b. Turn off
    - c. Turn on to last level
  7. Each load be configurable to operate in the following sequences based on occupancy:
    - a. Auto-on/Auto-off (Follow on and off)
    - b. Manual-on/Auto-off (Follow off only)
  8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
  9. BACnet object information shall be available for the following objects:
    - a. Load status
    - b. Schedule state, normal or after-hours
    - c. Demand Response enable and disable
    - d. Room occupancy status
    - e. Total room lighting watts
    - f. Electrical current
    - g. Total watts per controller

- h. Total room watts/sq ft.
  - i. Force on/off all loads
  - 10. UL 2043 plenum rated
  - 11. Manual override and LED indication for each load
  - 12. Zero cross circuitry for each load
  - 13. All digital parameter data programmed into an individual room controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
  - 14. Dimming Room Controllers shall share the following features:
    - a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
    - b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
    - c. The following dimming attributes may be changed or selected using a wireless configuration tool:
      - 1) Establish preset level for each load from 0-100 percent
      - 2) Set high and low trim for each load
      - 3) Initiate lamp burn in for each load of either 0, 12 or 100 hours
    - d. Override button for each load provides the following functions:
      - 1) Press and release for on/off control
      - 2) Press and hold for dimming control
    - e. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
    - f. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
    - g. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
    - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.
- B. On/Off Room Controllers shall include:
- 1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
  - 2. One or two relay configuration
  - 3. Simple 150 mA switching power supply (Only 4 100 series devices on a Cat 5e local network)
  - 4. Three RJ-45 DLM local network ports with integral strain relief and dust cover
  - 5. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/0-10V Dimming Room Controllers shall include:
- 1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 10A or 20A total load
  - 2. Optional real time current and voltage monitoring (with - M Monitoring option).
  - 3. One or two relays configurations
  - 4. Smart 150 mA switching power supply
  - 5. Two RJ-45 DLM local network ports. Provide molded strain relief ring
  - 6. One dimming output per relay
    - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting

7. Units capable of providing both Class 1 or Class 2 wiring for the 0-10V output
8. WattStopper product numbers: LMRC-111, LMRC-111-M, LMRC-112, or LMRC-112-M, LMRC-211, LMRC-212.

## 2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

- A. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
1. Digital calibration and pushbutton configuration for the following variables:
    - a. Sensitivity, 0-100 percent in 10 percent increments
    - b. Time delay, 1-30 minutes in 1 minute increments
    - c. Test mode, Five second time delay
    - d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - e. Walk-through mode
  2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
  3. Programmable control functionality including:
    - a. Each sensor may be programmed to control specific loads within a local network.
    - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
    - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
    - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      - e. Ultrasonic and Passive Infrared
      - f. Ultrasonic or Passive Infrared
      - g. Ultrasonic only
      - h. Passive Infrared only
      - i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
  4. One or two RJ-45 port(s) for connection to DLM local network.
  5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
  6. Device Status LEDs, which may be disabled for selected applications, including:
    - a. PIR detection
    - b. Ultrasonic detection
    - c. Configuration mode
    - d. Load binding
  7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
  8. Manual override of controlled loads.
  9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- B. BACnet object information shall be available for the following objects:
1. Detection state
  2. Occupancy sensor time delay
  3. Occupancy sensor sensitivity, PIR and Ultrasonic
- C. Units shall not have any dip switches or potentiometers for field settings
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the

free topology DLM local network. No additional configuration will be required.

- E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

## 2.5 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
  2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
  3. Configuration LED on each switch that blinks to indicate data transmission.
  4. Load/Scene Status LED on each switch button with the following characteristics:
    - a. Bi-level LED
    - b. Dim locator level indicates power to switch
    - c. Bright status level indicates that load or scene is active
    - d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
  5. Programmable control functionality including:
    - a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
    - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
  6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. BACnet object information shall be available for the following objects:
1. Button state
  2. Switch lock control
  3. Switch lock status
- C. Two RJ-45 ports for connection to DLM local network.
- D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
- E. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.
1. Individual button function may be configured to Toggle, On only or Off only.
  2. Individual scenes may be locked to prevent unauthorized change.
  3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
  4. Ramp rate may be adjusted for each dimmer switch.
  5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
  6. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

## 2.6 DLM HANDHELD USER INTERFACE REMOTES

- A. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching

or dimming control. Remote controls shall include the following features:

1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
  2. LED on each button confirms button press.
  3. Load buttons may be bound to any load on a load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
  4. Inactivity timeout to save battery life.
- B. Provide with a wall mount holster and mounting hardware for each remote.
- C. WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105.

## 2.7 DIGITAL DAYLIGHTING SENSORS

- A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.
1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
  2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
  3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone
- B. Digital daylighting sensors shall include the following features:
1. Sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
  2. Sensor light level range shall be from 1-6,553 foot-candles (fc).
  3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
  4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
  5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
  6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
  7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
  8. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
  9. Configuration LED status light on device that blinks to indicate data transmission.
  10. Status LED indicates test mode, override mode and load binding.
  11. Recessed switch on device to turn controlled load(s) ON and OFF.
  12. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
    - a. Light level
    - b. Day and night setpoints
    - c. Off time delay

- d. On and off setpoints
  - e. Up to three zone setpoints
  - f. Operating mode - on/off, bi-level, tri-level or dimming
13. One RJ-45 port for connection to DLM local network.
  14. A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inch thick (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
  15. Any load or group of loads in the room can be assigned to a daylighting zone
  16. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
  17. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
- C. Closed loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
  2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
  3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
  4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).
  2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
  3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
  4. WattStopper Product Number: LMLS-500, LMLS-500-L.

## 2.8 DIGITAL PARTITION CONTROLS

- A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.
- B. Four-button low voltage pushbutton switch for manual control.
1. Two-way infrared (IR) transceiver for use with configuration remote control.
  2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
  3. Configuration LED on each switch that blinks to indicate data transmission.
  4. Each button represents one wall; Green button LED indicates status.
  5. Two RJ-45 ports for connection to DLM local network.



6. WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.
- C. Coordinate contact closure interface for automatic control via input from limit switches on movable walls specified in Section 10 22 43 - Sliding Partitions .
  1. Operates on Class 2 power supplied by DLM local network.
  2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
  3. Input max. sink/source current: 1-5mA
  4. Logic input signal voltage High: > 18VDC
  5. Logic input signal voltage Low: < 2VDC
  6. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
  7. Two RJ-45 ports for connection to DLM local network.
  8. WattStopper part number: LMIO-102

## 2.9 HANDHELD CONFIGURATION TOOLS

- A. Provide a wireless configuration tool to facilitate customization of DLM local networks using two-way infrared communications, and/or PC software that connects to each local network via a USB interface. Deliver to maintenance supervisor.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:
  1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
  2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
  3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.
  4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
  5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
  6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
  7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
  8. Verify status of building level network devices.
- C. WattStopper Product Numbers: Handheld LMCT-100
- D. User Interface: Each lighting control panel system shall be supplied with at least one handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. User interface shall have the following panel-specific functions as a minimum:
  1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
  2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.

3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
7. WattStopper Product Number: LMCT-100

## 2.10 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

- A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handheld IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.
- B. Additional parameters exposed through this method include but are not limited to:
  1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
  2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
  3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
  4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
  5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
  6. Load control polarity reversal so that on events turn loads off and vice versa.
  7. Per-load DR (demand response) shed level in units of percent.
  8. Load output pulse mode in increments of 1second.
  9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.
- C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
  1. Device list report: All devices in a project listed by type.
  2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
  3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
  4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.

5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
  6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
  7. Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.
- D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
1. Set, copy/paste an entire project site of sensor time delays.
  2. Set, copy/paste an entire project site of sensor sensitivity settings.
  3. Search based on room name and text labels.
  4. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
  5. Filter by parameter value to search for product with specific configurations.
- E. Network-wide firmware upgrading remotely via the BACnet/IP network.
1. Mass firmware update of entire rooms.
  2. Mass firmware update of specifically selected rooms or areas.
  3. Mass firmware upgrade of specific products
- F. WattStopper Product Number: LMCS-100, LMCI-100

## 2.11 EMERGENCY LIGHTING CONTROL DEVICES

- A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
  2. Push to test button
  3. Auxiliary contact for remote test or fire alarm system interface
- B. WattStopper Product Numbers: ELCU-100, ELCU-200.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Do not begin installation until measurements have been verified and work areas have been properly prepared.
- B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

### 3.2 INSTALLATION

- A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.
- B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.
1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable

- shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
2. If fixtures have internal DLM Control Modules, ensure that they are also connected with Cat 5e cable.
  3. Install all room to room network devices using manufacturer-supplied LM-MSTP network wire or wireless devices. Network wire substitution is not permitted and may result in loss of product warranty.
  4. Low voltage wiring topology must comply with manufacturer's specifications.
  5. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.
- C. All line voltage connections shall be tagged to indicate circuit and switched legs.
- D. Test all devices to ensure proper communication.
- E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.
- F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
  2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
  3. Load Parameters (e.g. blink warning, etc.)
- G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.
- H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.
- I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.
- J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.
- K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.
- L. Remote Access for Network Systems: If "REMOTE ACCESS AND ENHANCED WARRANTY FOR NETWORKED SYSTEMS" is specified in Part 1 of this specification, ensure Segment Manager enclosure is installed in a location with good to excellent cellular phone coverage based on building orientation and geographic location, and mount magnetic antenna for the modem. For cases where alternate mounting locations are not available and a stronger cellular signal is needed, the manufacturer shall offer additional antenna options to improve signal quality. Verify final mounting location with Engineer and Owner prior to proceeding with the Work.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.
- B. Tests and Inspections: Manufacturer's service representative shall perform the following

inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
  2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
  3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
  4. Verify that the control of each space complies with the Sequence of Operation.
  5. Correct any system issues and retest..
- C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
1. Date of test or inspection.
  2. Loads per space, or Fixture Address identification.
  3. Quantity and Type of each device installed
  4. Reports providing each device's settings.

### 3.4 DEMONSTRATION AND TRAINING

- A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:
1. Confirmation of entire system operation and communication to each device.
  2. Confirmation of operation of individual relays, switches, and sensors.
  3. Confirmation of system Programming, photocell settings, override settings, etc.
  4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

### 3.5 PRODUCT SUPPORT AND SERVICE

- A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

### 3.6 FACTORY COMMISSIONING

- A. Factory commissioning shall include the following services. Programming of BMCS, all button stations, minimum and maximum light trim levels, verification of sensor coverage and configuration and relocation of all vacancy/occupancy sensors and photosensors as required for intended function and operation. Verification of a complete and working system.
- B. After 90 days from building permanent occupancy, re-calibrate sensor time delays and sensitivities to Owner's Satisfaction at no additional cost to the Owner. Provide a detailed report to the Architect / Owner of re-commissioning activity.
- C. After 11-months from substantial completion, re-calibrate sensor time delays and sensitivities to Owner's Satisfaction at no additional cost to the Owner. Provide a detailed report to the Architect / Owner of re-commissioning activity

END OF SECTION

## **SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

#### **1.3 QUALITY ASSURANCE**

- A. New: Provide all new equipment.
- B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
- D. NEC: Equipment and installation shall comply with the National Electrical Code.
- E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
- F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

#### **1.4 LABELING**

- A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

#### **1.5 FINISHES**

- A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

#### **1.6 SUBMITTALS**

- A. Provide complete product data for each equipment type. Provide electric service studies when required.
- B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings. Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

- C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

## 1.7 SHORT CIRCUIT CURRENT RATINGS

- A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

## 1.8 ELECTRIC SERVICE STUDIES

- A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.
- C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.
- D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.
- E. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.
- F. Coordination studies shall be submitted and approved prior to purchasing of electrical equipment. Contractor shall comply with any recommendations from the study engineer i.e. changing of breaker size and feeder size to ensure all upstream and downstream equipment are fully coordinated.

## 1.9 OWNER'S INSTRUCTION

- A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. Instruction shall include a functional training session on digital metering system operation and system test procedures.

Demonstrate the transfer of metered values to the Building Automation System. Review manufacturer's recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

- B. All transformers and switchboards shall be pad mounted on concrete housekeeping pad.
- C. Provide spare breakers and conduit out of the nearest switchboard or distribution panel for a minimum of (8) portable buildings (16 Classrooms). Provide minimum two 2-inch conduits with pull strings to each location. Location of the portable buildings, size and quantity of circuit breakers and conduits to be determined during design as directed by CFISD.
- D. Contractor shall review conduit connections to all equipment to ensure the proper fittings are installed.
- E. Contractor shall ensure all equipment is properly grounded when the installation is complete. Install equipment grounding conductor in all raceways. Install grounding bushings where concentric or eccentric knockouts or reducing bushings are used. Bond all boxes to equipment grounding conductor
- F. Ensure all breakers and disconnects are accurately labeled upon substantial completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

#### **Switchboard, DP's, Panels, MCC's and Disconnect Switches, Circuit Breaker**

- A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. All electrical components shall be listed and labeled by a NRTL for their intended use. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
  - 1. Schneider Square D
  - 2. Siemens
  - 3. ABB G.E.

#### **Transformer**

- 1. Powersmiths (E-Saver OPAL)
- 2. PQI (EY e-Rated)
- 3. Mirus (ULLTRA)

### **2.2 ENCLOSED SWITCHES**

- A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.
- B. Switch Interior:
  - 1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
  - 2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
  - 3. All current carrying parts shall be plated to resist corrosion.
  - 4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
  - 5. Switches shall have provisions for a field installable electrical interlock.



- C. Switch Mechanism:
1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
  2. The operating handle shall be an integral part of the box, not the cover.
  3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
  4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
  5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- D. Switch Enclosures:
1. Switch covers shall be attached with welded pin-type hinges.
  2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
  3. The enclosure shall have ON and OFF markings stamped into the cover.
  4. The operating handle shall be provided with a dual colored, red/black position indication,
  5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
  6. Tangential knockouts shall be provided to facilitate ease of conduit entry.
- E. Switch Ratings:
1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
  2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
  3. Non-Fusible: 10,000 rms symmetrical amps.
- F. Fuse Clips: NEMA FU 1, Class J fuses.

### **2.3 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES**

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.
- C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.
- D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
  2. Exterior Locations: Type 3R.
- E. Nameplate: Provide a nameplate showing load served.

## 2.4 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

- A. Square D - Class 2510 Type F.
  - 1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
  - 2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

## 2.5 MAGNETIC MOTOR CONTROLLERS

- A. Square D - Class 8536 Type S.
  - 1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
  - 2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
  - 3. Coil: Be of encapsulated type.
  - 4. Poles: as indicated.
  - 5. Size: as indicated.
  - 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
  - 7. Wiring: Straight-through wiring with all terminals clearly marked.
  - 8. Overload Relay: NEMA ICS.
    - a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
    - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
    - c. Reset: Unit shall include both manual reset and remote reset using an external module.
    - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
  - 9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
  - 10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
  - 11. Provide red LED running pilot light and H-O-A switch.

## 2.6 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

- A. Square D - Class 8810 Type S.
  - 1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
  - 2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
  - 3. Coil: Be of encapsulated type.
  - 4. Poles: as indicated.
  - 5. Size: as indicated.
  - 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
  - 7. Contact inspection and replacement shall be possible without disturbing line or load wiring.

8. Wiring: Straight-through wiring with all terminals clearly marked.
9. Overload Relay: NEMA ICS.
  - a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
  - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
  - c. Reset: Unit shall include both manual reset and remote reset using an external module.
  - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

## **2.7 COMBINATION DISCONNECT / MOTOR STARTERS**

- A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).
  1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
  2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
  3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

## **2.8 FUSES (600 VOLTS AND BELOW)**

- A. Manufacturers:
  1. Bussmann.
  2. Little Fuse
  3. Ferraz Shawmut
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Class J (Time Delay) Fuses
  1. Dimensions and Performance: NEMA FU 1.
  2. Voltage: Rating suitable for circuit phase-to-phase voltage.
  3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.
- E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

## 2.9 TWO-WINDING TRANSFORMERS

- A. Product Description: Provide transformers in accordance with the following standards, where applicable:
  - 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
  - 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
  - 3. NEMA ST 20, Dry Type Transformers for General Applications
  - 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
  - 5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
  - 6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.
- B. Ratings as indicated on Drawing.
- C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.
- D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.
- E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.
- F. Winding Taps:
  - 1. 2 at 2.5 percent above rated voltage.
  - 2. 4 at 2.5 percent below rated voltage.
- G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.
- H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.
- I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- J. Mounting:
  - 1. 1-15 kVA: Suitable for wall mounting.
  - 2. 16-75 kVA: Suitable for floor mounting.
  - 3. Larger than 75 kVA: Suitable for floor mounting.
- K. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.10 TRANSFORMERS FOR NONLINEAR LOADS

- A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.

- B. All busing components and all windings and busing shall be copper
- C. Provide minimum 30kVA distribution transformers. Transformer sizes larger than 30 kVA shall be based on the calculated demand kVA for the load served unless directed to be larger by CFISD. NEC calculation requirements generally provide adequate conservative over-sizing and spare capacity for most real-world load conditions. Do not oversize distribution transformer unless directed by CFISD.
- D. Minimum 10-year manufacturer's warranty.
- E. Energy efficiency shall exceed DOE 2016 requirements on average by 20% for combined no-load, linear loads, and non-linear loads between no-load and 50% loading for an estimated pay-back of less than 5-years.
- F. Final assembly shall be in North America.
- G. Equipment shall be rated for the application.
- H. All products shall be constructed to NEMA standards.
- I. Maximum temperature rise 115C at 40C, and minimum Class 220C insulation.
- J. Minimum K-7 rated or harmonic mitigating as required for load served.
- K. Noise levels 3dB below NEMA ST-20.
- L. Copper electrostatic shield.
- M. Transformers used inside shall be minimum NEMA 2. Transformers located outside shall be minimum NEMA 3RX with gray finish.
- N. Rubber vibration isolators.
- O. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.
- P. Primary Voltage: 480 volts, 3 phase.
- Q. Secondary Voltage: 208Y/120 volts, 3 phase.
- R. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.
- S. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.
- T. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- U. Isolate core and coil from enclosure using vibration-absorbing mounts.
- V. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

## 2.11 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Square D I- Line, Class 2110.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Continuous current rating shall be sufficient to protect wiring and equipment served.
  - 1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
  - 2. Panels greater than 400A: 65,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Main Circuit Breaker:
  - 1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
  - 2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
  - 3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.
- G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

## 2.12 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;
- D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.
- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

- H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
- I. Provide ground-fault circuit breaker for each heat trace branch circuit.
- J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

#### 2.14 MAIN SWITCHBOARDS:

- A. General: Provide universal building-type switchboards fabricated in accordance with NEMA Standard PB-2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.
- B. Structure:
  - 1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1-1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
  - 2. When "SPACE" is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.
- C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.
- D. Instrumentation:
  - 1. General: Monitor the incoming line with a ION S7650A0C0B6E0A0A. Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
  - 2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).
- E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 3000 amperes and shall be full height.** Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension**. Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full-size neutral rated at 100 percent of phase bus.

- F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.
- G. Short Circuit Ratings:
1. Switchboard assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to 100,000 amps RMS symmetrical at nominal system voltage.
- H. Provisions for Auto Power Factor Controller (APFC):
1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
  2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.
  3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
  4. Refer to Section 26 35 33 for additional requirements of auto pf controller.
- I. Protective Devices:
1. Switchboard Main Breaker:
    - a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D NW (3000-4000), 100KA ampere frame size.
    - b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
    - c. Minimum interrupting rating of 100,000 amperes rms symmetrical at 480/277 Volts.
    - d. Local trip indicators: overload, short circuit and ground fault.
    - e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
    - f. Adjustments:
      - 1) The electronic trip unit shall have LSIG Trip functions.
  2. Feeder Devices:
    - a. Breakers 700 Amps and Larger:
      - 1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated 100% with electronic trip units, similar to Square D PJ (700-1200A 65kaic 100%).
      - 2) Interrupting rating shall be at least 65,000 amperes rms symmetrical at 480/277 Volts.
      - 3) The electronic trip unit shall have LSI trip functions.
      - 4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.
    - b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
    - c. The breaker shall be UL Listed for continuous duty at 100% of the current rating
- J. Transient Voltage Surge Suppressor (TVSS):
1. General: Provide a Square D Class 1310 240kA surge current rated mounted adjacent to switchboard.
- K. Lightning and Overvoltage Surge Arrester:



1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.
2. Description: Device shall be a heavy duty, three-phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.

L. Identification:

1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard \_\_\_\_\_  
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz  
Main Bus: \_\_\_amps. braced for \_\_\_ RMS sym. amps.  
Date Installed:

M. Submittal: Include at least the following:

1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings
7. Protective Device Ratings
8. Electronic metering system
9. Surge Arrester
10. Unit Elevation
11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials
12. Original Manufacturer Brochure and Specifications
13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.

N. Testing: Test all devices and systems to assure proper operation.

**2.17 ELEVATOR SHUNT TRIP DISCONNECT**

- A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.
- B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.
- C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

**2.18 ROOF MOUNTED PEDESTALS**

- A. Roof Utility Pedestal with 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products utility roof pedestal #MPX-20G: 36/12.

- B. Roof Pedestal with Non-Fused Disconnect Switch and 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products roof pedestal #MDP – (XX). See plans for disconnect sizes.

### **PART 3 - EXECUTION**

#### **3.1 MOUNTING:**

- A. General: All equipment shall be securely fastened in place.
- B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.
- C. Concrete Pads:
  - 1. Provide concrete in accordance with the Division of the Specifications for that product.
  - 2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
  - 3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.
- A. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.
- B. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

#### **3.2 DELIVERY, STORAGE AND HANDLING:**

- A. General:
  - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
  - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
  - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
  - 4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.

5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
  6. Contractor shall store all electrical materials in clean, dry location protected from weather, dust, dirt and damage.
- B. Approved Conditions for Equipment Storage:
1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
  2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
    - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
    - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
    - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
    - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.
- C. Transformer
1. Indoor storage shall be provided for all transformers.

### **3.3 GROUND FAULT PROTECTION OF EQUIPMENT:**

- A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

### **3.4 TRANSFORMER VIBRATION ISOLATION:**

- A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.
- B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.
- C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.
- D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent

of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

**3.5 TRANSFORMER VENTILATION:**

- A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

**3.6 POWER SHUT OFF UNDER KITCHEN HOODS:**

- A. NFPA:
  - 1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
  - 2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
  - 3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
- B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. Coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.
- C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system. Refer to Section 26 05 53 for additional fire alarm system requirements.

**3.7 LABELING:**

- A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

**3.8 WARRANTY:**

- A. One year from Date of Substantial Completion.
- B. Contractor to submit and coordinate directly with CFISD regarding all manufacturer warranties including extended warranties periods beyond project close-out to ensure these warranties are in effect and enforceable by CFISD. Otherwise the contractor shall assume responsibility for the provisions set forth in the extended warranties at no additional cost to CFISD.

**END OF SECTION 26 20 00**

## **SECTION 26 27 26 - WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

#### **1.3 REFERENCES**

- A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.
- C. Minimum Raceway Size: 3/4 inch.

#### **1.4 SUBMITTALS**

- A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

### **PART 2 – PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
  - 1. Hubbell
  - 2. Pass & Seymour
  - 3. Leviton
  - 4. Molex Woodhead for Cord Reels
  - 5. Hubbell for Cord Reels

#### **2.2 GENERAL**

- A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.
- B. Provide industrial grade “Grey” wiring devices, where industrial grade not available provide specification or hospital grade.
- C. Provide red color wiring devices for emergency and stand-by circuits powered by a generator, UPS, or inverter system.

- D. Install all receptacles with the ground connection down.
- E. Oversize (Jumbo) cover plates are not acceptable.

### 2.3 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
  - 1. Hubbell model 1221, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
  - 1. Hubbell model 1222 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
  - 1. Hubbell model 1223, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:
  - 1. Hubbell model 1224, 20A, 120/277V.
- E. Indicator Switch, Toggle Style:
  - 1. Hubbell Series, 20A, 120/277V. Switch illuminated when load is on.
- F. Locator Switch, Toggle Style:
  - 1. Hubbell Series, 20A, 120/277V. Switch illuminated when load is off.
- G. Digital Time Switch:
  - 1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.
- H. Key lock switches:
  - 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
  - 2. 20 Amp rated.
  - 3. 120/277 Volt ac rated.
  - 4. Key-lock mechanism can only be turned ON or OFF with key.
  - 5. Single pole: Leviton 1221-2KL or approved equal.
  - 6. ONLY Hubbell model (1121L with 1209 key for each switch) Keyed switches  
Provide 302 stainless steel wall plate for each switch.
  - 7. Provide 2 keys on ring for each switch.
  - 8. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
  - 9. Key all switches alike to match the owners standard key. Coordinate with school District for key match.
- I. Color: gray.

## 2.4 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.
- B. Leviton MMS Series.

## 2.5 WALL DIMMERS

- A. Manufacturers:
  - 1. Leviton AW series for line voltage dimming.
- B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.
- C. Body and Handle: Linear slide handle, color as selected by Architect.
- D. Voltage: 120 volts.

## 2.6 RECEPTACLES

- A. Single Convenience Receptacle:
  - 1. Simplex 20A-125V self-grounding, NEMA 5-20R, Hubbell 536
- B. Duplex Convenience Receptacle:
  - 1. Duplex 20A-125V self-grounding, NEMA 5-20R, Hubbell 5362
- C. GFCI Receptacle:
  - 1. GFCI, 20A-125V, NEMA 5-20R w/feed through, Hubbell GF-5362
  - 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).
- D. Isolated Ground Duplex Receptacle:
  - 1. Isolated ground duplex, 20A-125V, NEMA 5-20R, Hubbell IG5362
- E. Duplex Tamper Resistant Receptacle/ USB Charger
  - 1. Duplex 20A/125V receptacle by Hubbell
- F. Provide 20 amp receptacle for single-receptacle branch circuits.
- G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.
- H. Color: Gray. Red for emergency.

## 2.7 CORD REELS

- A. Receptacle only, 201A, Hubbell #HBL45123GF220WM1 with #HBL340PB pivot base
- B. Hand Lamp only; Hubbell #HBL50162FL with #HBL340PB pivot base (automotive repair garage location)

## 2.8 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

- B. Exterior cover plates shall be Thomas & Betts CKSUV cast aluminum standard depth, locking mount, while-in-use wet location, universal configuration.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Route raceway and cable to meet Project conditions.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.
- D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- E. Install devices plumb and level.
- F. Install receptacles with ground pin down.

#### **3.2 MOUNTING HEIGHTS**

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

#### **3.3 GANGED SWITCHES**

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

#### **3.4 GFCI**

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

#### **3.5 WARRANTY**

- A. One year from Date of Substantial Completion.

**END OF SECTION 26 27 26**



## **SECTION 26 32 13 - EMERGENCY GENERATORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Provide an emergency power system for emergency egress lighting, fire alarm system, emergency elevator operation, and other emergency power loads required.
- B. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.
- C. Products supplied but not installed under this section. Products shall be turned over to the Owner.
  - 1. Emergency generator system equipment as follows:
    - a. Complete set of all special tools required to operate and service the equipment as recommended by the manufacturer for field maintenance.
    - b. One oil filter replaceable element.
    - c. One air filter replaceable element.
- D. Related Sections:
  - 1. Division 1 - General Requirements
  - 2. Applicable sections of Division 16 - Electrical
  - 3. For emergency generators: Fuel gas piping, exhaust gas piping, flexible pipe connections, cooling air duct work, assembling generator accessories.
- E. Power Source: Provide an on-site engine-generator set to generate power for distribution to emergency and standby loads by the emergency power distribution system. Engine-generator set shall be constructed of all-new components.
- F. Transfer: Power to emergency loads shall be automatically transferred from normal utility power to the emergency engine generator upon loss of normal power. Transfer and assumption of load shall occur in ten (10) seconds or less. Loads shall be automatically retransferred upon restoration of normal source.
- G. Distribution System: Distribution equipment devices, and circuits shall be provided as required to distribute power to emergency loads.

#### **1.3 REFERENCES**

- A. Emergency generators shall be in accordance with the latest applicable standards as recommended by, SAE, IEEE, and ANSI/NEMA MG-1 Motors and Generators.

## 1.4 SUBMITTALS

- A. Shop Drawings:
1. Emergency generator systems including:
    - a. Engine-generator set and foundation requirements.
    - b. Auxiliary and remote equipment.
    - c. Make of engine, number of cylinders, compression ratio, bore and stroke, cylinder displacement, and speed.
    - d. Make of generator, electrical rating, number and type of bearings, and exciter type.
  2. Plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
  3. Product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer and vibration isolators.
  4. Installation instructions.
  5. Name, location and phone number of nearest authorized distributor/service facility.
  6. Sequence of Operation - Manufacturer shall prepare a detailed, typewritten sequence of operation and submit as part of the approval documents. Final approved sequence of operation shall be permanently encapsulated in plastic laminate and permanently attached to the equipment. Format shall be 8½" x 11" or 11" x 17" as appropriate.
  7. Include schematic one-line diagram with appropriate symbols and nomenclature properly referenced to text.
- B. Product Data:
1. Specification Review: A complete item by item, line by line specification review.
  2. Output current Amperes and electrical kW rating of engine-generator set.
  3. Brake horsepower rating of engine.
  4. Fuel consumption at 100 percent, 75 percent and 50 percent load.
  5. Cooling requirements.
  6. Sound level (dBA measured on longitudinal and perpendicular axis at ten (10) feet).
  7. Manufacturer's technical data for generator, governor, voltage regulator, and battery charger. Governor submittal shall also identify method of overspeed protection to be furnished.
  8. Generator sub-transient reactance  $X_d''$ , per unit
  9. Generator short circuit current, three-phase amperes.
  10. Generator voltage waveform distortion, measured at Full Load, line-neutral, both total harmonic distortion (THD) and maxim single harmonic order THD.
  11. Generator output circuit breaker(s), including proof or UL listing.
  12. Transfer Switch: Show complete data showing compliance. Include continuous and withstand current ratings of all contacts.
- C. Manuals and Test Data
1. Operation and Maintenance Manuals for all major components including instructions for normal operation, routine maintenance requirements, service manuals for generator, engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

## 1.5 QUALITY ASSURANCE

- A. Authority Having Jurisdiction:

ENGINE GENERATORS  
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1. General: The system shall comply with all applicable Codes and Ordinances as interpreted and enforced by the local authority having jurisdiction.
- B. National Electrical Code: The system shall comply with NFPA 70, National Electrical Code, including: 1) Article 445, 2) 700.
- C. NFPA:
  1. General: Comply with applicable requirements of NFPA Standards, including the following:
    - a. NFPA 37: Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines.
    - b. NFPA 101: Life Safety Code.
    - c. NFPA 110: Standard for Emergency and Standby Power Systems.
      - 1) Type ten (10) seconds.
      - 2) Natural gas utility pipeline.
      - 3) Category B (engine-generator set).
      - 4) Level 1
    - d. NFPA 54: National Fuel Gas Code.
- D. UL:
  1. General: Comply with applicable requirements of UL Standards, including the following.
    - a. UL 1008: Automatic Transfer Switches, Fourth Edition or later.
    - b. ANSI / NEMA: Comply with applicable requirements of ANSI / NEMA MG 1, "Motors and Generators", and MG 2, "Safety and Use of Electric Motors and Generators".
    - c. IEEE: Comply with applicable portions of IEEE Std 446-1987, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications" (Orange Book)
- E. EPA:
  1. General: Comply with all applicable EPA requirements.

## 1.6 OWNER'S INSTRUCTIONS

- A. Provide a four (4) hour period of instruction to the Owner's designated personnel upon completion of the system installation. Run engine-generator set and review remote annunciator panel for typical readings. Explain operation of generator remote stop switch. Demonstrate complete transfer sequence of utility-generator-utility. Operations & Maintenance Manual shall be complete and on-site for use during Owner's Instruction.

## 1.7 WARRANTY

- A. Furnish full parts and labor warranty to cover the entire engine generator package and automatic transfer switch including all accessories, components, controls, batteries, etc. for five years. Warranty shall begin from date of Certificate of Substantial Completion. Provide a sample of manufacturer's warranty certificates within equipment submittal. Warranty start dates from shipment or start up will not be accepted.
- B. In addition to full parts, labor, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, oils, lubricants, belts, filters, etc. and any expenses related to service calls required to diagnose and correct warranty issues. No purchase order number shall be required by the owner for service calls within warranty period. Purchase order number can be issued after problem is determined not to be a warranty issue.

- C. The manufacturer shall provide factory certificates for each Generator and associated Automatic Transfer Switch listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- D. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing contractor.

## 1.8 MAINTENANCE

- A. Furnish one set of tools required for preventative maintenance of each engine generator system. Package tools in adequately sized metal tool box.
- B. Provide two spare sets of each oil, and air filter element required for each engine generator system.

## PART 2 - PRODUCTS

### 2.1 GENERAL INFORMATION

- A. Furnish and install new natural gas engine driven electric generating unit, factory assembled single unit generator set, with continuous output voltage of 480Y/277, 3 phase, 4 wire, at 0.8 power factor, 60 hertz, grounded neutral service, fully rated for operation at the job site altitude at an ambient temperature range of 120 degrees Fahrenheit maximum to -0 degrees Fahrenheit minimum, all mounted on a common steel base suitable for mounting on a concrete foundation pad, complete with a derangement panel and all accessories as specified and required for normal operation in standby service.
- B. Acceptable Manufacturers:
  - 1. Caterpillar
  - 2. Cummins/Onan
  - 3. Kohler
- C. Manual and Automatic Start - Unattended Operation
  - 1. Manual start shall be done by operating the "start" button on the generator or selecting "manual" on the manual-off-automatic selector switch on the automatic transfer switch.
  - 2. Automatic start shall be done by the automatic transfer switch when the manual-off-automatic selector switch on the automatic transfer switch is in the "automatic" position.
- D. Voltage and frequency regulation.
  - 1. Engine/generator shall deliver rated output (kVA) at rated frequency and power factor, at not more than two (2) percent above or below rated voltage.
  - 2. Voltage regulation shall be plus or minus two (2) percent for any constant load between no load and rated load. Random voltage variation shall not exceed  $\pm 1$  percent for any constant load. Voltage recovery to 100 percent normal output shall take no longer than two seconds after single step application of 100 percent rated load.
  - 3. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 1.8 hertz. Frequency adjustable from 57 hertz to 63 hertz ( $\pm 5$  percent)

4. The engine-generator set shall be capable of single step load pick up of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- E. The alternator shall produce a clean AC voltage waveform, with not more than five (5) percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than three (3) percent in any single harmonic.
- F. Furnish all necessary electrical connections, transfer switch, control panel, relays, etc., for installation of new generator set.
- G. Generator and engine shall be mounted on vibration isolating supports capable of 95 percent isolation to minimize vibration of the remainder of the skid-mounted equipment and transmission of vibration to the supporting pad.
- H. Generator shall be fully enclosed or suitably guarded to prevent exposure to all parts which operate at extremely high temperatures, electrically energized, or rotating. All noncurrent carrying parts shall be grounded.
- I. Thoroughly clean all equipment, and prime and finish paint with manufacturer's standard paint finish.
- J. Outdoor Weather-Protective Housing: Factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation and exclude entry of moisture into interior components. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color.

## 2.2 ENGINE

- A. Engine shall be standby power rated, multi-cylinder, spark ignited four stroke cycle, liquid cooled, internal combustion engine for use with natural gas fuel, industrial type, designed for full rated power output at 1800 rpm, 60 hertz. The engine shall be arranged for direct connection to the alternating current generator.
- B. Governor shall be electronic isochronous type no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Random frequency variation shall not exceed  $\pm 0.25\%$  of its mean value for constant loads from no load to full load. Governor shall be provided with means for manual operation and adjustment.
- C. Lubrication system.
  1. Full pressure type with engine driven positive displacement sump pump,
  2. Full flow strainer,
  3. Full flow filter,
  4. Pressure relief and automatic bypass valves,
  5. Crankcase ventilator with filter and connection for outside venting,
  6. Bayonet type oil level indicating pressure gauges on the upstream and downstream side of the strainer and filter,
  7. Drain connection,
  8. Oil cooler,
  9. Low oil pressure safety shutoff device,
  10. Provide water shutoff valves and drain on the oil cooler to facilitate draining water without draining the complete engine cooling system.
  11. Provide a radiator coolant level sight glass.

- D. Cooling system.
  - 1. Pressure type, with radiator, blower type fan,
  - 2. Engine driven circulating pump,
  - 3. Radiator cap incorporating a pressure-vacuum valve,
  - 4. Thermostat in conjunction with a radiator bypass,
  - 5. Drain connection,
  - 6. High coolant temperature safety device,
  - 7. Fan shall be sized to maintain safe engine temperature in ambient temperature of 120 degrees Fahrenheit,
  - 8. Provide gaskets and packing in the cooling system which are unaffected by ethylene glycol base coolant,
  - 9. Provide a 50% ethylene glycol antifreeze solution for the coolant,
  - 10. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct for directing discharge air through the wall,
  - 11. Radiator and Air Intake/Discharge System Flow Restriction requirement shall be no less than 0.5 inches of water.
  
- E. Provide thermal circulation type engine jacket water heater with integral thermostatic control, sized to maintain minimum coolant temperature of 49 degrees Celsius down to an ambient temperature or 0 degrees Celsius. The heater shall be disconnected whenever the engine starts by an oil pressure switch mounted on engine. Connect heater to 120 volt normal power panel as indicated on Drawings. Install tag at connection on generator to identify power panel and circuit number.
  
- F. Air intake system shall be complete with a dry type filter, and high frequency filter-type silencer for reducing the sound level at the intake to a point acceptable for residential use.
  
- G. Air shutoff for emergency shutdown.
  
- H. Engine exhaust system shall be complete with stainless steel critical type silencer capable of reducing ambient exhaust noise level to 60 dBA when measured 50 feet from the engine under full engine load and clear weather. Silencer shall be supported independently of the engine. Flexible exhaust connection shall be provided from the engine exhaust manifold to the silencer. An exhaust condensation trap with manual drain valve shall be provided to prevent condensation from entering the engine. Furnish and install a steel rain cap at the exhaust stack outlet. Rain cap shall have a high-temp paint finish.
  
- I. Standard SAE nuts, bolts, and studs.
  
- J. Standard NPT or SAE tubing and fittings.
  
- L. Gas Train for Natural Gas Fuel System:
  - 1. General: Provide all fuel system components necessary to allow the generator system to operate under continuous emergency full load. Gas regulator train assembly shall be designed for engine manufacturer's recommended gas pressure from a nominal five (5) pound per-square-inch natural gas service. Install components furnished with engine.
  - 2. Engine-mounted carburetor.
  - 3. Fuel gas pressure regulators with vibration isolating, flexible fuel line joint on gas-supply side.
  - 4. Solenoid valve that automatically shuts off flow of gas if the engine stops for any reason. Install this valve on gas-supply side of gas pressure regulator.

5. Gas pressure gauge with analog display of ounces-per-square-inch to monitor gas supply pressure. Install this gauge in gas train inside the generator set housing.
6. Gas line service regulator with atmospheric vent.
7. Dry filter for vapor withdrawal.
8. Manual shut-off valve.
9. Gas surge tank or other components as may be recommended by engine supplier.
10. Gas fuel line for Emergency Power System shall be connected ahead of the main gas shutoff valve for the building with a separate, dedicated shutoff valve. Mark both generator gas valve and building gas valve with permanent signs to indicate that there is another valve, per NFPA 110, sect. 5-9.7.

### **2.3 GENERATOR**

- A. Generator shall be alternating current, three phase, four pole, reconnectible brushless revolving field synchronous type with brushless exciter directly connected to the generator field windings without slip rings or commutators.
- B. Generator shall have a single prelubricated sealed bearing, direct connected to the engine, by means of a flexible disc coupling for self-alignment and air cooled by a direct drive centrifugal blower fan.
- C. Insulation shall be minimum Class F in a self-ventilated enclosure. Temperature rise shall be 130 degrees Celsius max over ANSI 40 degrees Celsius ambient for standby service.
- D. Bring out all leads from each winding to a generator main lead terminal box adequate in size for making up all connections and grounding the neutral to the generator set supporting frame.
- E. Voltage regulation shall include True RMS 3 phase sensing, generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics. Include manual controls to adjust voltage output plus or minus 5 percent of nominal voltage level.
- F. The generator shall have the necessary excitation control circuitry to prevent the loss of excitation on fault conditions allowing quick return to full voltage and power to normal and faulted circuits.
- G. Furnish NEMA 1 output terminal and outgoing cable termination compartment integral with the engine-generator frame.
- H. Output Breakers: Provide output molded case circuit breakers of adequate capacity and rating. Provide output breaker for each output circuit running from generator. Breaker shall be UL Listed 100 percent rated for continuous operation at full ampacity. Provide cable extensions and enclosure required to integrally mount output circuit breaker inside outdoor generator housing. Enclosure shall comply with NEC 404-3.
- I. Housing Alternator shall have an open drip-proof construction.

### **2.4 VOLTAGE REGULATION**

- A. Static type, three phase, mounted either on the generator control panel or combined with the exciter. Voltage shall have "manual-automatic" switch and be adjustable +/- 10 percent under all operating conditions.

### **2.5 ELECTRIC STARTING SYSTEM**

- A. Engine starting system shall be a 12 volt or 24 volt DC system depending on size of engine/generator, consisting of a heavy duty electric cranking motor(s) with drive mechanism, heavy duty batteries with metal frame or box, engine driven alternator, battery charger, and transistorized voltage regulator.
- B. Cranking motor shall be capable of starting the engine five times in rapid succession without overheating the motor and at sufficient speed for starting in low ambient temperatures.
- C. Storage batteries shall be lead acid type of voltage and capacity as determined by the engine manufacturer, with sufficient capacity to start the generator set five times consecutively in rapid succession. Provide all battery cables and connections. Provide hydrometer.
- D. Battery charger shall be an automatic, self-protected, self-regulated, dual rate rectifier type of a capacity determined by the engine manufacturer and sufficient to automatically recharge the batteries quickly according to the requirements governed by battery discharge duty, and suitable for 120 volt, single phase, 60 hertz input service from a remote receptacle panel.

## 2.6 ENGINE-GENERATOR CONTROL PANEL

- A. Control panel shall be engine generator frame mounted in NEMA 1 enclosure, totally front accessible. Control panel shall be completely factory pre-wired. All external connections shall be wired out to terminal blocks for field wiring. Control panel shall be complete with all engine and generator controls and indicators. Include front hinged double doors with latches and provision for padlock.
- B. Control panel shall provide a contact closure to initiate operation of the ventilation system. Wire out to terminal block. Contact shall be field wired by manufacturer as indicated on the Drawings.
- C. Control panel shall include the following fully identified by means of permanent nameplates:
  - 1. Control
    - a. Output voltage adjustment.
    - b. Cranking limiter relay.
    - c. Overspeed shutdown.
    - d. Low oil pressure shutdown.
    - e. High coolant temperature shutdown.
    - f. Remote Alarm Contacts: Pre-wired SPST contacts to terminal strip for remote indication of all alarm functions.
    - g. Battery operated service light to illuminate panel during power outage conditions.
    - h. Manual-off-auto engine start switch.
  - 2. Visual monitoring
    - a. Frequency Meter: 45-65 Hz range, 3½ inch (89 mm) dial.
    - b. AC Output Voltmeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch (phase-to-phase and phase-to-ground).
    - c. AC Output Ammeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch and 3 current transformers.
    - d. Push-to-test indicator lamps, one for each:
      - 1) Engine run
      - 2) Low oil pressure
      - 3) High water temperature
      - 4) Overspeed and overcrank

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- 5) Overspeed shutdown
  - 6) Failure to crank
  - 7) Failure to establish voltage or frequency.
  - 8) Failure to reach rated voltage at transfer switch in ten (10) seconds
- e. Engine running time meter.
  - f. Electrical oil pressure gauge.
  - g. Electrical water temperature gauge.
  - h. Mechanical fuel pressure gauge.
  - i. Radiator sight glass.
  - j. DC voltmeter and ammeter.
3. Audible monitoring
- a. Low oil pressure alarm condition.
  - b. High coolant temperature alarm.
  - c. Failure to crank.
  - d. Failure to establish voltage or frequency.
  - e. Failure to reach rated voltage at transfer switch in ten (10) seconds.
- D. Battery charging system including alternator and solid state regulator.
- E. Remote Annunciator NFPA 110: Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.  
Locate annunciator in the Administration Area per owner's instruction.

## 2.7 WEATHER PROTECTIVE ENCLOSURE

- A. Standard Enclosure:
1. Steel weather protective enclosure with 14 gauge sheet metal and a minimum ambient capability of 43 degrees Celsius (110 degrees Fahrenheit). Shall have removable, and / or hinged doors and removable end panels to allow easy routine maintenance. All hinges and latches shall be rust resistant and doors shall be equipped with rubber seals. A lockable service access cover shall be provided for easy access to the radiator fill cap. The enclosure shall be painted utilizing electrostatically applied powder baked paint.

## 2.8 AUTOMATIC TRANSFER SWITCHES

- A. Furnish and install automatic transfer switches (ATS) with four (4) poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.
- B. Acceptable Manufacturers:
1. ASCO
  2. Caterpillar
  3. Cummins
  4. GE
  5. Zenith
  6. Kohler
- C. Mechanically Held Transfer Switch

1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
3. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

D. Microprocessor Controller

1. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
2. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to  $\pm 1$  percent of nominal voltage. Frequency sensing shall be accurate to  $\pm 0.2$  percent. The panel shall be capable of operating over a temperature range of -20 to +60 degrees Celsius and storage from -55 to +85 degrees Celsius.
3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
4. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
5. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
  - a. EN 55011:1991 Emission standard - Group 1, Class A
  - b. EN 50082-2:1995 Generic immunity standard, from which:
    - 1) EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
    - 2) ENV 50140:1993 Radiated Electro-Magnetic field immunity
    - 3) EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
    - 4) EN 61000-4-5:1995 Surge transient immunity

5) EN 61000-4-6:1996 Conducted Radio-Frequency field immunity

c. IEEE472 (ANSI C37.90A) Ring Wave Test.

E. Enclosure

1. The ATS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.

F. Controller Display and Keypad

1. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

- a. Nominal line voltage and frequency
- b. Single or three phase sensing
- c. Operating parameter protection
- d. Transfer operating mode configuration (Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

G. Voltage, Frequency and Phase Rotation Sensing

1. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E,3φ	70 to 98%	85 to 100%
Overvoltage	N&E,3φ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- 2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.
- 3. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- 4. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- 5. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

H. Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.

2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
  - a. Prior to transfer only.
  - b. Prior to and after transfer.
  - c. Normal to emergency only.
  - d. Emergency to normal only.
  - e. Normal to emergency and emergency to normal.
  - f. All transfer conditions or only when both sources are available.

I. Additional Features

1. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
2. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
3. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
4. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
5. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
  - a. The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
    - 1) Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
    - 2) Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
    - 3) An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require

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external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.

- J. Engine Exerciser: The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
1. Enable or disable the routine.
  2. Enable or disable transfer of the load during routine.
  3. Set the start time,
    - time of day
    - day of week
    - week of month (1st, 2nd, 3rd, 4th, alternate or every)
  4. Set the duration of the run.  
At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- K. Withstand and Close-On Ratings
1. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
  2. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
- L. Tests and Certification
1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- M. Service Representation
1. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Provide all work required for a complete system, including complete system testing and checkout. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

### **3.2 EMERGENCY DISTRIBUTION SYSTEM**

- A. All boxes, and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system. Emergency circuits shall be specially marked and shall be run in raceway separate from normal powered circuits. All

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distribution equipment shall be specifically indicated "EMERGENCY" on the equipment nametag. Color code for emergency markings and all nametags shall be RED.

### **3.3 COMMISSIONING SERVICE**

- A. A final inspection and an initial startup of the system shall be rendered by the authorized factory representatives.
- B. A letter of certification written by the authorized factory representatives, which states that the system is properly installed and does properly function as recommended by the factory and as described in this specification, shall be submitted to the Architect for his approval.
- C. A test run shall be performed by the authorized factory representative in the presence of the Owner, Architect and Engineer; the time of this test run shall be mutually agreed upon by all persons concerned. This test run may, but is not required to, coincide with other testing requirements described in this section.

### **3.4 INSTALLATION**

- A. General: Provide all labor required for a complete installation.
- B. Mounting: Anchor on a four (4) inch concrete pad with bolts and elasto-rib vibration isolators. Pad shall extend a minimum of 18 inches from each side of the generator set skid.

### **3.5 CONSUMABLES**

- A. Refuel during testing as required. After all tests have been performed, fuel tanks shall be filled before system is accepted by Owner. Check oil, coolant, batteries, filters and other consumables. Top off and replace as necessary to leave engine-generator set at full capacity for all consumables.

### **3.6 TESTING**

- A. Factory Testing: The engine generator shall be tested at the factory, demonstrating its performance at full rated load. A certified copy of the test report shall accompany the unit to the field and shall be made available to the building official and copied to the Architect and Engineer.
- B. Field Testing: Conduct tests of the system as required by NEC Article 700 in the presence of the Owner, Architect, Engineer, and Code Authority having jurisdiction. The engine generator set shall demonstrate the actual sequencing of all load onto the generation unit and shall carry the building emergency loads, including any elevator(s), for a minimum period of two (2) hours. Contractor shall insure that all emergency loads are operational before scheduling this test. Test times shall be mutually agreed upon by all persons concerned.

### **3.7 SYSTEM GROUNDING**

- A. The emergency power system generator output shall be grounded as a separately derived system according to the requirements of the Section titled GROUNDING. Bond the generator neutral to the generator ground.

### **3.8 SIGNS**

- A. Refer to Section 16075, Electrical Identification for Sign Requirements.

- B. Service Entrance: A sign shall be placed at the normal power service entrance indicating location of the emergency power engine-generator set.
- C. Generator: Provide a sign arranged to be prominent and legible at the set control panel. Sign shall be an OSHA orange WARNING sign plus text. Sign text shall be "Warning - This equipment starts automatically. Disconnect all sources of supply and load before servicing", or similar approved text.
- D. Fuel Tank: Provide a "Caution - No Smoking" sign on the housing. Sign shall be an OSHA yellow caution sign with text and graphic no-smoking symbol. Provide sign per NFPA 110 Sect. 5.9.7 at both generator gas shut-off valve and building gas shut-off valve to indicate that there is another valve.

### **3.9 REMOTE WIRING**

- A. General: Provide raceway, wiring and control cables from generator control panel to remote points. Underground conduits may be direct buried without concrete encasement if a red plastic warning tape is installed above each conduit.
- B. Remote Points:
  - 1. Engine-Generator Remote Panel
  - 2. Automatic Transfer Switches
  - 3. Automatic Battery Charger. Provide dc wiring from remote charger to battery rack at engine-generator set. Size wire for maximum 2 percent dc voltage drop at full load.
  - 4. Generator control power 120V branch circuit.
  - 5. Engine water jacket heater branch circuit.
  - 6. Outdoor generator housing: battery rack warming jacket 120V branch circuit.
  - 7. Outdoor generator housing: generator strip heater 120V branch circuit. One circuit may serve both jacket heater and generator heater if total load including voltage drop is less than 80% circuit ampacity.
  - 8. Elevator Controllers; (Signals shall be taken from ATS).
  - 9. Building Automation System (BAS); (BAS wires to the ATS).
  - 10. Building Security System
  - 11. Emergency Lighting Automatic Transfer Switches

### **3.10 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES**

- A. Provide automatic slave transfer switches where indicated on the drawings for transfer of dimmer branch circuits utilized for emergency lighting.

**END OF SECTION 26 32 13**

## **SECTION 27 41 16 - INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Integrated Audio-Video Systems and Equipment as part of the Work.

#### **1.2 RELATED DOCUMENTS**

- A. General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this section.
- B. Reference the Project Manual for related specification sections.
- C. Reference the Project Drawings for additional information.

#### **1.3 SECTION INCLUDES**

- A. Project instructions for the Contractor and System description details
- B. System product description
- C. Project completion instructions for the Contractor

#### **1.4 RESPONSIBILITY**

- A. Responsibilities include, but are not limited to, the following items:
  - 1. Provide materials, equipment, transportation, and labor necessary for a fully working, tested, and calibrated system. Supply accessories and minor equipment items (such as, but not limited to, power strips, adapters, connectors, mounting hardware, etc.) needed for a complete system, even if not specifically mentioned in these Specifications. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.
  - 2. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Architect for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Architect.
  - 3. Execute work in accordance with the National Electrical Code (NEC), the National Electrical Safety Code, the Occupational Safety and Health Act (OSHA), applicable State and Local codes, ordinances, regulations, authority having jurisdiction (AHJ), and manufacturer's recommendations. If a conflict develops between the contract documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform Work.
  - 4. Required licenses, insurance and permits including payment of charges and fees
  - 5. Verification of dimensions and conditions at the job site.
  - 6. Coordinate location and installation of equipment with other building elements.
  - 7. Preparation of submittal information
  - 8. Pick-up of Owner Furnished Equipment (OFE) and incorporation into project if applicable.
  - 9. Development and implementation of control system software code and control panel layouts, which will become the property of the Owner
  - 10. Final tests and adjustments, written report, and documentation



11. Instruction of operating personnel
12. Provision of manuals
13. Maintenance services and warranty.

## 1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
1. American National Safety Institute (ANSI)
  2. American Society of Testing and Materials (ASTM)
  3. Electronics Industries Association (EIA)
  4. Federal Communications Commission (FCC)
  5. National Electrical Manufacturer's Association (NEMA)
  6. National Electrical Code (NEC)
  7. Underwriters Laboratories (UL)
  8. Occupational Safety and Health Administration (OSHA)
  9. Society of Motion Picture and Television Engineers (SMPTE)
  10. Building Industry Consulting Service International (BICSI)
  11. Davis and Davis, Sound System Engineering (3rd Edition) (SSE), Howard W. Sams, 2006
  12. Giddings, Audio System Design and Installation (ASDI), Howard W. Sams, 2013
  13. AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm (AVIH), 2009

## 1.6 DEFINITIONS

- A. In addition to those Definitions of Division 1, the following list of terms as used in this specification shall be defined as follows:
1. Furnish - To purchase, procure, acquire, and deliver complete with related accessories.
  2. Install – To set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, items, or equipment supplied by Contractor.
  3. Provide – To furnish and install.

## 1.7 DESCRIPTIONS & REQUIREMENTS

- A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the systems.
- B. Cafetorium
1. Audio Sources
    - a. Provide an assortment of dynamic and condenser microphones.
    - b. Provide wired microphone inputs around stage.
    - c. Provide ceiling mounted microphones over the stage for choral performances.
    - d. Provide a wireless microphone system with remote mounted antennas including handheld and body-worn transmitters.
    - e. Provide a rack mounted multi-media player for music playback at the main portable and stage control positions.
    - f. Provide a rack mounted multi-media recorder for music recording at the main portable and stage control positions.
    - g. Provide wired and wireless media connectivity.
    - h. Provide cabling and equipment accessories.
  2. Mixing System
    - a. Provide a rack mounted digital mixing system in the main portable rack.
    - b. Provide a rack mounted mixer at the stage control position for simple operation.
  3. Processing and Amplification

- a. Provide a dedicated audio DSP for signal routing and processing.
- b. Provide DSP amplification for loudspeakers.
- c. Provide audio system control via networked control system.
4. Loudspeakers
  - a. Provide ceiling loudspeakers distributed across the seating areas.
  - b. Provide ceiling subwoofers distributed across the seating areas.
  - c. Provide loose loudspeakers for on-stage monitoring.
5. Equipment Housing
  - a. Provide a portable equipment rack for the main control position.
  - b. Provide permanent floor-supported wall mounted equipment rack for storage of equipment.
6. Hearing Assist
  - a. Provide a wireless, single channel radio frequency hearing assist system.
  - b. Provide a remote mounted antenna to provide coverage of the audience area.
  - c. System must operate on approved FCC frequencies.
  - d. Provide enough portable receivers to meet current ADA standards including:
    - 1) Ear speakers
    - 2) Headsets
    - 3) Inductive coil loops
7. Life Safety
  - a. Provide a contact closure from the life safety system.
  - b. System to mute upon contact closure and remain muted during the alarm.
  - c. System to continue previous operation when alarm has ended.
8. AV Presentation Systems
  - a. The AV presentation system in the auditorium will provide one large, centered screen projected display of video sources.
  - b. The display will utilize a projection screen that is recessed within the header of the proscenium wall. The screen will be motorized so that it can be raised (out of sight) when not in use.
  - c. All sources being shown through the AV system should be distributed from a rack-mounted matrix switcher.
  - d. Source audio will be played through the room audio system.
  - e. AV Sources shall include:
    - 1) A video input from each stage floor box
    - 2) A video input from a rear wall plate
    - 3) Wireless Presentation System
    - 4) Digital Signage Player
  - f. Control of the AV presentation system (Projector power, screen up/down, source selection, etc.) should be simple and intuitive. Color touch screen control panels will be provided for use; one at the stage managers position one inside the control room, and one in the amp rack.
9. Production AV Infrastructure
  - a. A panel for AV tie line connections will be located in the rear of the cafeteria.
  - b. Tie line connections will terminate in an equipment rack panel that serves as a patch bay.

## 1.8 SUBMITTALS

- A. Provide submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures section unless otherwise indicated.
- B. Submittals shall contain sufficient information to describe the Work to be performed. Reviewed shop drawings are to be used for final coordination and construction.
- C. Shop drawings must be original work produced by the Contractor responsible for performing the work defined in this specification. Scanning, photographic copying, materially copying, or any

other reproducing the contents of the drawings or specifications contained within the Contract Documents will be marked as unacceptable and not reviewed for any content. No claim shall be made for delay, undue burden, or additional costs for the effort to produce shop drawings, schedules, and equipment lists addressing this specification or the overall project manual.

D. Supplementary submittal requirements:

1. Provide the following in one electronic submission for review within thirty days of issuance of Notice to Proceed (NTP) and prior to commencement of Work:
  - a. Complete schedule of submittals.
  - b. Chronological schedule of Work in bar chart form.
  - c. Product Data Sheets:
    - 1) Provide a complete table of contents with the following information:
    - 2) Project title.
    - 3) Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
    - 4) Date of submission.
    - 5) Provide a list of and Manufacturer's data sheets on products to be incorporated with the Work. Arrange data sheets in the same order they appear in this specification. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
    - 6) Submit manufacturer's product literature for each type of firestop material to be used. Literature shall include documentation of UL classifications or approved third party testing. Manufacturer's name and number for each part shall be included. Submit drawings of through penetrations, which include the system to be utilized for the firestopping application. Drawing shall indicate construction of wall or floor assembly; size, number and material of penetrating items; firestop system designation; required F-rating, T-rating and remarks.
    - 7) Upon Owners and/or Consultant's request provide (3) three copies of the submittals. Bind submittal in titled three ring D style binders sized for 150 per cent of the material. Maximum size: three-inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs.
    - 8) Submissions that do not follow the format and configuration described above will be returned without review.
  - d. Shop Drawings:
    - 1) Functional Diagrams/Schematics:
      - a) Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and designators, and device designators for each system. Provide connector designations and terminal strip identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use this designator consistently throughout the project.
    - 2) Coordination Drawings:
      - a) Prepare and submit a set of coordination drawings showing major elements, components, and devices of the audio and video system in relationship with other building components. Prepare drawings to an accurate scale of 1/8"=1'-0" or larger on suitable sized media.
      - b) Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all equipment. Indicate locations where space is limited, and where sequencing and coordination of installations is of importance to the efficient flow of the Work including but not necessarily limited to the following:
        - (1) Equipment housings

- (2) Ceiling and wall mounted devices
  - (3) Raceways
  - (4) Cabling
- e. Equipment: Location of equipment within racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
- f. Patch panel(s): Layouts and designation (labeling) strips, including color schemes.
- g. Full fabrication details of any custom enclosures and millwork indicating size, material, finish and openings for equipment.
- h. Structural rigging and mounting details:
  - 1) Loudspeaker rigging, suspension, and mounting detail drawings shall be signed and sealed by a professional engineer licensed to practice in the state in which the project is located. The signed and sealed drawings noted above to include the following:
    - a) Analysis of all components in the load path and attachment method to building structure for suspended loudspeakers.
    - b) Attachment method for mounting brackets at ceilings, walls, or other building features.
    - c) Detail the product manufacturer, part numbers, and load capacity of the hardware fittings and materials selected for suspended or mounted loudspeakers.
    - d) A copy of the design calculations.
    - e) Secondary steel required for attachment to the building structure.
    - f) Custom brackets, mounts, suspension grids or trusses, loudspeaker cabinet frames, or loudspeaker brackets.
    - g) Loudspeaker brackets or mounts provided by the specific loudspeaker manufacturer being installed that do not include traceability data.
  - 2) Risk analysis data as referenced in Part 3.2, F
  - 3) Stamping Engineer post-installation sign-off as described in Part 3.2, F
  - 4) Proof of ETCP certification for on-site rigging crew.
- i. Projector, loudspeaker, camera mounting details, include hardware types and load capacity.
- j. Fabricated Plates and Panels
  - 1) Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
- k. Labeling
  - 1) Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
- l. Schedules
  - 1) Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting and location. Include this information with remainder of wiring diagrams.
- m. Control System Software
  - 1) Provide electronic copies of proposed control system user interfaces within sixty (60) days of issuance of Notice to Proceed (NTP).
- n. IP Addresses
  - 1) Coordinated with the venue IT Administrator, provide a list of IP addresses, by device, used in the project.
- o. Consultant's project documents in electronic format will not be supplied to the Contractor for their use as part of submittals.
- p. Detail drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0".

- q. Submissions that do not follow the format and configuration described above will be returned without review.
- r. Any other pertinent data which is necessary to provide the Work.
- 2. Control System Software:
  - a. Provide electronic copies of proposed control system user interfaces within sixty (60) days of issuance of Notice to Proceed (NTP).
- E. Resubmission requirements:
  - 1. Make all requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
  - 2. Indicate all changes that have been made other than those requested.

### 1.9 CONTRACT CLOSE-OUT DOCUMENTS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures section unless otherwise indicated, after substantial completion but prior to final observation:
- B. Supplementary submittal requirements:
  - 1. Provide the following in one electronic submission for review.
    - a. Equipment Manuals:
      - 1) Manufacturer's owner/instruction manual for each type of Product by manufacturer and model or part number unless specified otherwise herein
      - 2) Supply manufacturer's serial numbers for each Product
      - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item
      - 4) Separately bind list by manufacturer and model or part number of Products incorporated within the Work, arranged in alpha numeric order. When applicable, bind Manufacturer's warranty statements separately.
    - b. Test Reports: Recorded findings of Commissioning.
    - c. Signed copy of turn over equipment to Owner including quantity, make and model.
    - d. Copy of any program or hardware setup files.
    - e. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
      - 1) This procedure should describe the operation of system capabilities.
      - 2) Assume the intended reader of the manual to be technically inexperienced but unfamiliar with the components and the facility.
    - f. Provide Consultant with copy of Owner training video.
    - g. Service Information, including service phone number(s) and hours; service schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
    - h. Any other pertinent data generated during the Project or required for future service.
    - i. Within three (3) weeks of final observation, submit the following in one electronic submission for review. Upon Owners and/or Consultant's request provide (3) three copies of the following:
      - 1) Record drawings: Final rendition of Shop Drawings depicting what is actually incorporated within the Work.
      - 2) Hardcopy full size set of Record drawings.
      - 3) Three (3) compact disc or DVD's containing Record drawings in AutoCAD editable DWG format and Adobe PDF format. Resolution to be sufficient to permit Owner's technicians to be able to clearly read all notes and text on screen.
      - 4) One set of signed proof-of-training documents.
  - 2. Submittal Format:
    - a. Record Drawings: Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0".

- b. Segregate documents into separate binders containing data relevant to operational, maintenance, and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.
  - c. Bind Project Record Manual in titled three ring D style binders sized for 150 per cent of the material. Maximum size: three inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs.
- C. Resubmission requirements:
- 1. Make all requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
  - 2. Indicate all changes that have been made other than those requested.

## 1.10 CUSTOM SOFTWARE

- A. Introduction:
- 1. Proprietary software provided for the Technical Systems shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
  - 2. Contractor shall agree that 3rd party proprietary software provided with the system shall be subject to this agreement.
  - 3. Contractor and Owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties; and shall supersede any standard manufacturer or Contractor's standard license agreement.
  - 4. Proprietary software shall be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.
  - 5. For sake of this agreement, MS Windows® shall not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.
- B. License Grant and Ownership:
- 1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the Owner.
  - 2. Except as expressly set forth in this agreement, Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties or service contracts provided by third parties in connection with any software, hardware or other software or services provided in the system shall be delivered to Owner for the sole benefit of Owner.
  - 3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.
- C. Copies, Modifications, and Use:
- 1. Source code shall be available to Owner for a period of not less than 10 years.
  - 2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of Owner and its representatives.

3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right for Owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.

D. Warranties and Representations:

1. Contractor represents and warrants to Owner that:
  - a. It has all necessary rights and authority to execute and deliver this Software License and perform its obligations hereunder and to grant the rights granted under this Software License to Owner;
  - b. The goods and services provided by contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners; and
  - c. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
2. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.
3. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third party intellectual property rights.

### 1.11 QUALITY ASSURANCE

- A. Qualifications: Contractor to be experienced in the provision of systems similar in complexity to those required for this project, and meet the requirements listed below. Provide documentation at the time of bid to support these qualifications:
1. Form of corporation.
  2. No less than three years' experience with equipment and systems of the specified types.
  3. Experience with at least three comparable scale projects within the last three years.
  4. Be a franchised dealer and service facility for the manufacturer's products furnished.
  5. Maintain a fully staffed and equipped service facility with full-time field technicians.
  6. Have at least one supervisory on-site employee who has completed and has been certified CTS-I by Infocomm.
  7. Supervision of all rigging by an ETCP certified rigger for all work associated with suspension or mounting of overhead equipment.
  8. Adequate plant capacity and equipment to complete the Work.
  9. Adequate staff with commensurate technical experience.
  10. Suitable financial status (i.e., bonding and materials purchase capacity) to meet the obligations of the Work.
  11. Adequate regional service organization to meet warranty response requirements of the Project.
  12. Provide listing with appropriate explanation regarding the status of Contractor's resolved or unresolved legal disputes within the last six calendar years.
  13. Provide listing with appropriate explanation regarding any projects within the last 3 years where the Contractor has failed to meet construction schedules due to Contractor's cause.
  14. Completed current version of the AIA Contractor's Qualification Form.

- B. Subcontractors: at the time of bid, the Contractor shall provide a list of structural, electrical, sound, or any other subcontractors intended to do the Work, or are being retained as local service providers throughout the warranty period. Subcontractors shall be appropriately state licensed in their specialty and must provide the same qualification documents as the Contractor.
- C. Work: Perform Work in compliance with the applicable standards listed herein and governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
  - 1. Drawings and specification requirements govern where they exceed Code and Regulation requirements.
  - 2. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
  - 3. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.
- D. Coordinate exact location and installation of equipment, power, grounding, and raceway requirements with the Architect.

#### **1.12 DELIVERY, STORAGE & HANDLING**

- A. Ship Products in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with Manufacturer's recommendation.
- C. Provide protective covering during construction of all installed devices, to prevent damaging or entrance of foreign matter.
- D. Replace at no expense to Owner, Products damaged during storage, handling or the course of construction.

#### **1.13 PROJECT CONDITIONS**

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to Architect for approval, showing how the work may be installed.

#### **1.14 WARRANTY**

- A. Warrant labor and equipment for one year following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or equipment within the Warranty period without charge.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within twenty four (24) hours during normal working hours and correct the deficiency within forty eight (48) hours.
- D. Provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Closeout Documents.



- E. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment (OFE). Coordinate observation visit with the Owner.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Products quantity is as required. If a quantity is given, provide at least the given amount. Some product listed may not be required to fulfill the obligations of the Work.
- B. Equipment and materials shall be new and conform to applicable UL or ANSI provisions.
- C. Regardless of the length or completeness of the descriptive paragraph herein, provide Products complying with the specified manufacturer's published specifications.
- D. Remove or blank out all manufacturers' names, logos, or other symbols from loudspeakers or other objects placed in view of the public. If logos are removable, remove and repaint to the color of the adjacent surface and reattach.
- E. Take care during installation to prevent scratches, dents, chips, etc.

### **2.2 ACCEPTABLE MANUFACTURERS**

- A. Model numbers and manufacturers included in this specification are listed as a standard of function, performance, and quality.
- B. Refer to General and Supplementary Conditions and Division 1 Specification Sections for equipment substitution procedure.
- C. If a specified product has been discontinued by a manufacturer, provide the replacement model (as certified by the manufacturer) at no additional cost.
- D. Where required provide manufacturer's rack mount adapter or one manufactured by Middle Atlantic or Winstead unless specified elsewhere.

### **2.3 MICROPHONES AND ACCESSORIES**

- A. Quad Wireless Microphone System (WRLS Type 1):
  - 1. Receiver Type: Digital Wireless System with automatic switching diversity reception with XLR type audio output connectors.
  - 2. Indicators: LED signal strength meters for battery, RF and audio levels.
  - 3. Frequency: Coordinate with FCC and local requirements.
  - 4. Antennas: Rear mount passive antennas for the frequency spectrum chosen.
  - 5. 1-RU Rack mountable.
  - 6. Acceptable Product:
    - a. Shure ULXD4Q Diversity Receiver
- B. Bodypack Wireless Microphone (Type 1)
  - 1. Theatrical headset/lapel mic
  - 2. Acceptable Product:
    - a. Shure ULXD1 Bodypack Transmitter
      - 1) Shure SB900B Lithium Ion Battery

- 2) Shure UL4/C-MTGQ-A Cardioid Lavalier Microphone
  - 3) Shure MX153 Headset Microphone (coordinate color with Owner)
- C. Handheld Wireless Microphone (Type 1)
- 1. Beta 87A capsule
  - 2. Acceptable Product:
    - a. Shure ULXD2/B87A Handheld Transmitter
    - 1) Shure SB900B Lithium Ion Battery
- D. Wireless Microphone Charge Base (Type 1)
- 1. 8 Port Wireless Microphone Charging Dock
  - 2. Acceptable Product:
    - a. Shure SBC800-US Battery Charger Base
- E. Vocal Microphone: (Type 1)
- 1. Handheld dynamic cardioid pattern
  - 2. Acceptable Product:
    - a. Audix OM6
    - b. Shure Beta58a
    - c. Approved Equivalent
- F. Choir Microphone: (Type 1)
- 1. Hanging condenser
  - 2. HyperCardioid pattern
  - 3. Acceptable Product:
    - a. Audix ADX40HC
    - b. Shure MX202B/S
- G. Podium Microphone (Type 1)
- 1. Goose neck condenser microphone
  - 2. Cardioid pattern
  - 3. Acceptable Product:
    - a. Shure MX412/C
- H. General Purpose Microphone: (Type 1)
- 1. Handheld dynamic cardioid pattern
  - 2. Acceptable Product:
    - a. Shure SM58
    - b. Approved Equivalent
- I. Suspended Microphone: (Type 1)
- 1. Phantom powered
  - 2. Acceptable Product:
    - a. Audix ADX40 with CPSADXC cardioid capsule
    - b. Shure MX202B/C
    - c. Approved Equivalent
- J. Microphone Stands and Mounting Hardware:
- 1. Acceptable Product:
    - a. TYPE 1: Round-base floor stands, Black
      - 1) Atlas MS-10CE w / PB11XEB
      - 2) Approved Equivalent
    - b. TYPE 2: Heavy Duty floor stand, Black
      - 1) Atlas SB11WE
      - 2) Approved Equivalent
    - c. TYPE 3: Boom Arm Short, Black

- 1) Atlas PB11XEB
- 2) Approved Equivalent
- d. TYPE 4: Boom Arm Long, Black
  - 1) AtlasPB21XEB
  - 2) Approved Equivalent
- e. TYPE 5: Tabletop stand, Black
  - 1) Atlas SMS2B
  - 2) Approved Equivalent

## 2.4 INPUT SOURCES

- A. Media Player (MDP, Type 1):
  - 1. Analog and outputs: RCA unbalanced.
  - 2. 1-U Rack Mountable.
  - 3. Bluetooth Receiver
  - 4. USB & Aux input
  - 5. Wireless Remote Control.
  - 6. Acceptable Product:
    - a. Tascam CD-400U
- B. Media Recorder (MDR, Type 1):
  - 1. Analog inputs and outputs: RCA unbalanced.
  - 2. Digital input and output: S/PDIF, AES/EBU
  - 3. 1-U Rack Mountable.
  - 4. AMFM Tuner
  - 5. Bluetooth Receiver
  - 6. USB & Aux input
  - 7. RS-232 Control
  - 8. Wireless Remote Control.
  - 9. Acceptable Product:
    - a. Tascam SS-R250N
- C. Mono DI Box (Type 1):
  - 1. Inputs for unbalanced line sources
  - 2. Inputs shall be via ¼" receptacles
  - 3. Line and mic level outputs
  - 4. Ground lift switch
  - 5. Acceptable Product:
    - a. Whirlwind DIRECTOR
    - b. Radial ProDI
    - c. Approved Equivalent
- D. Stereo DI Box (Type 1):
  - 1. Inputs for stereo/dual mono unbalanced line sources
  - 2. Inputs shall be via ¼", RCA, 3.5mm receptacles
  - 3. Line and mic level outputs
  - 4. Ground lift switch
  - 5. Acceptable Product:
    - a. Whirlwind DIRECT2
    - b. Radial ProAV2
    - c. Approved Equivalent
- E. Stereo Computer DI Box (Type 1):
  - 1. Inputs for stereo/dual mono unbalanced line sources
  - 2. Inputs shall be via ¼", RCA, 3.5mm receptacles
  - 3. Line and mic level outputs

4. Ground lift switch
5. Acceptable Product:
  - a. Whirlwind PC-DI
    - 1) ProCo BPMBMB-3 3.5mm TRS Cable
  - b. Radial JPC
    - 1) ProCo BPMBMB-3 3.5mm TRS Cable
  - c. Approved Equivalent

- F. Stereo Computer USB DI Box (Type 1)
1. Inputs shall be via USB receptacle
  2. Mic level outputs
  3. Acceptable Product:
    - a. Whirlwind PC-USB
    - b. Radial USB-Pro
    - c. Approved Equivalent

- G. Bluetooth Receiver (BTRX, BTIO, Type 1)
1. Input: Bluetooth
  2. Output: balanced analog audio.
  3. Provides long distance distribution of Bluetooth audio using Cat6 cable.
  4. Powered from receiver in rack.
  5. Does not support automatically pairing.
  6. Customizable Bluetooth name.
  7. Coordinate finish with Architect
  8. Acceptable Product to Include:
    - a. RDL BT1A (BTRX)
    - b. RDL TX-TPR2A (BTIO)

- H. Analog Stereo to AES Converter (AES, Type 1)
1. Inputs: 2x balanced analog, 2x unbalanced analog
  2. Outputs: 1x AE3
  3. Acceptable Product:
    - a. RDL HR-ADC1
    - b. Approved Equivalent

## 2.5 MIXERS

- A. Mixing Console (MIXER, Type 1):
1. Digital audio mixing surface
  2. Touch screen LCD
  3. Local Analog and Digital IO
  4. Digital Audio Network compatible
  5. Set virtual inputs/output labels to match connector labeling
  6. Acceptable Product:
    - a. Yamaha DM7
- B. Stage Rack I/O (MIX IO, Type 1):
1. Digital Audio Network compatible
  2. Rack Mounted
  3. 16 balanced inputs
  4. 8 balanced outputs
  5. Acceptable Product
    - a. Yamaha Rio1608
- C. Mixer (MIXER, Type 2):
1. 6 input rack mount mixer

2. 6 mono mic/line inputs
3. 3 stereo line inputs
4. Stereo line output
5. 2 mono line outputs
6. Acceptable Product:
  - a. TOA M-633D

## 2.6 DIGITAL SIGNAL PROCESSORS

- A. Digital Signal Processing System (DSP)
1. Provide independent DSP processing for each system as detailed on the AV drawings.
  2. The DSP system and control software shall be operational 30 days prior to the first use of the installed system.
  3. Function: Provide all signal processing and control required for the system(s). Devices required include, but are not limited to; mixer, matrix router, crossover, high and low pass filters, delay, compression, 6-band parametric equalizer, limiter, ducker, signal delay, and external control.
  4. Unit to be configured with a minimum quantity of inputs and outputs as shown within the AV drawings, including control port requirements.
  5. Signal flow and routing to be fully user configurable.
  6. Unit to permit hardware connection of external switches for recalling presets.
  7. Unit to permit remote networked control via dedicated devices.
  8. Access to external user-adjustable controls shall be restricted.
  9. Manufacturer Software:
    - a. Provide 12 months of on-site software upgrades from date of final acceptance.
  10. DSP Software Setup:
    - a. Provide site specific configuration and programming for the DSP software.
    - b. Coordinate user interface, software functionality, and menu screens with Architect's Consultant. Reference submittal requirements.
    - c. Provide ongoing software upgrades and maintenance for 12 months from date of final acceptance.
    - d. Reference Part 3.4 System Programming in this specification for additional programming details.
  11. Where DSP and Amplifiers are used in the same system, use processing and amplification products of the same platform.
- B. Digital Signal Processor (DSP, Type 1)
1. Acceptable Product:
    - a. QSC Q-Sys Core 110f
    - 1) QSC QIO-GP8x8
- C. Digital Signal Processor Input/Output Expander (DSP IO, Type 1)
1. Acceptable Product:
    - a. QSC QIO-ML4i
    - b. QSC QIO ML2x2
    - c. QSC QIO L4o

## 2.7 POWER AMPLIFIERS

- A. General:
1. Two, Four, or Eight channel power amplifier with the EIA standard RS-490 power rating at 1% THD into 70-volt constant voltage load or 8-ohm load as applicable.
  2. Provide protection of circuit components in the event of input over-drive, output overload, or short circuits.
  3. Frequency response:  $\pm 1$  dB, 20 Hz to 20 kHz with less than 1 per cent THD at rated output.

4. Input impedance: 10k ohm balanced.
5. Output regulation: 2 dB from no load to full load conditions.
6. Noise generation: at least 85 dB below rated output with input shorted.

- B. Acceptable products:
1. Type 1:
    - a. QSC CX-Q 2K4
  2. Type 2:
    - a. QSC CX-Q 4K Series

## 2.8 LOUDSPEAKERS

- A. General
1. Coordinate loudspeaker/grille and hardware colors with Owner
  2. Provide all necessary mounting hardware, brackets, supports and any secondary steel required to attach loudspeaker to building structure.
- B. Speaker (Type 1)
1. Type: ceiling loudspeaker
  2. Configuration: 6.5-inch driver and a 1-inch dome tweeter
  3. Frequency Response: 55 Hz – 20 kHz
  4. Power: 150W @ 8 ohms
  5. Taps: 60W / 30W / 15W / 7.5W @ 70V
  6. Coverage: 120 degree conical
  7. Acceptable Product:
    - a. JBL Control 47CT
    - b. QSC AC-C6T
- C. Speaker (Type 2)
1. Type: ceiling subwoofer
  2. Configuration: 8-inch driver
  3. Frequency Response: 32 Hz – 300 Hz
  4. Power: 200W @ 8 ohms
  5. Acceptable Product:
    - a. JBL Control 40CS
    - b. QSC AD-C.SUB
- D. Speaker (Type 3)
1. Type: Compact surface mount two-way, full-range loudspeaker
  2. Configuration: 12-inch woofer, 90° x 50° horn
  3. Frequency Response: 62Hz – 19kHz
  4. Power: 600W program @ 8Ω
  5. Sensitivity: 95dB (1W/1m)
  6. Acceptable Product:
    - a. JBL PRX412M
- E. Speaker Stand (Type 1)
1. Height adjustable
  2. Supports up to 120 lbs
  3. Acceptable Product:
    - a. On Stage SSP7900
    - b. Approved Equivalent

## 2.9 LOUDSPEAKER HARDWARE AND SUPPORT STRUCTURE

- A. All rigging truss modules, slings and hardware to meet a minimum of one of the following standards.
  - 1. ASME B30.26
  - 2. ASME B30.9
  - 3. OSHA 1910.184
  - 4. OSHA 1926.251
  - 5. UL 1480 31.3
  
- B. Shoulder Type Machinery Eye Bolts:
  - 1. Forged Steel - Quenched and Tempered.
  - 2. Fatigue rated at 1-1/2 times the Working Load Limit at 20,000 cycles.
  - 3. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
  - 4. Select size of product based working load limits required.
  - 5. Acceptable Product:
    - a. Crosby Group S-279 / M-279 Series
  
- C. Forged Eye Nuts:
  - 1. Forged Steel - Quenched and Tempered.
  - 2. Tapped with standard UNC class 2 threads after galvanizing.
  - 3. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
  - 4. Select size of product based working load limits required.
  - 5. Acceptable Product:
    - a. Crosby Group G-400 Series
  
- D. Anchor Shackles:
  - 1. Forged - Quenched and Tempered, with alloy pin.
  - 2. Working Load Limit permanently shown on every shackle.
  - 3. Hot Dip galvanized or Self-Colored.
  - 4. Product to meet the performance requirements of Federal Specification RR-C-271D Type IVA, Grade A, Class1.
  - 5. Select size of product based working load limits required.
  - 6. Provide all screw pin type shackles with mouse wire.
  - 7. Acceptable Product:
    - a. Crosby Group G-213 / S-213 Series Round Pin
    - b. Crosby Group G-209 / S-209 Series Screw Pin
  
- E. Turnbuckles:
  - 1. Acceptable turnbuckle assembly combinations include: Eye and Eye, Jaw and Jaw, Jaw and Eye.
  - 2. End fittings are Quenched and Tempered, bodies heat treated by normalizing.
  - 3. Hot Dip galvanized.
  - 4. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
  - 5. Product to meet the performance requirements of Federal Specifications FF-T-791b, Type 1 Form 1 - CLASS 4, and ASTM F-1145.
  - 6. Select size of product based working load limits required.
  - 7. All end fittings to be moused to the body with mousing cable.
  - 8. Acceptable Product:
    - a. Crosby Group HG-226 Series, Eye and Eye
    - b. Crosby Group HG-227 Series, Jaw and Eye
    - c. Crosby Group HG-228 Series, Jaw and Jaw
  
- F. Wire Rope:
  - 1. Strands: 7 x 19 Utility Cable.

2. Type: Galvanized.
3. Select size of product based working load limits required.
4. Acceptable Manufacturer:
  - a. Wire Rope Corporation of America (WRCA)

G. Wire Rope Thimble:

1. Product to meet the performance requirements of Federal Specification FF-T-276b Type II.
2. Hot Dip galvanized.
3. Select size of product based wire rope size required for suspended load.
4. Acceptable Product:
  - a. Crosby Group G-411 Series

H. Wire Rope Sleeves:

1. Type: Copper Duplex.
2. Select size of product based wire rope size required for suspended load.
3. Acceptable Product:
  - a. Wire Rope Corporation of America (WRCA) SW-740 Series

## 2.10 ASSISTIVE LISTENING

A. ALS Transmitter (ALT, Type 1):

1. Configuration: Single-channel.
2. Frequency: 216 MHz.
3. Audio Input: Balanced, mic or line level, 3-pin XLR.
4. Provide power supply.
5. Provide 1-RU rack mount bracket.
6. Remote mounted antenna (ANT-HA)
7. Acceptable Product:
  - a. Listen Technologies LS-71-216
    - 1) Listen Technologies LA-124 for device/panel mounted antennas

B. ALS Receiver (Type 1):

1. Configuration: Single channel.
2. Frequency: 216 MHz.
3. Frequency agile to adjust various systems.
4. Receivers to be frequency adjustable for use in all venues.
5. Include an individual price for owner to purchase additional receivers.
6. Acceptable Product:
  - a. Listen LR-4200-216 Receiver
    - 1) Listen LA-401 Ear Speaker
    - 2) Listen LA-402 Headset
    - 3) Listen LA-430 Neck Loop

## 2.11 PROJECTION SCREENS

A. Large Electric Projection Screen (PS, Type 1)

1. General: Provide manufacturer's standard units consisting of screen and other components as required for a complete installation.
2. Provide rigging and mounting hardware as required.
3. Comply with the following requirements for the viewing surface:
  - a. Tab tensioned screen
  - b. HD Progressive 1.1 surface material
  - c. Aspect Ratio: 16:9
  - d. Low voltage controller



4. Provide custom black drop as required to locate bottom of image as shown in drawings. This extra black drop amount needs to be calculated in the field based on the actual finished installation height.
5. Screen size: Reference Projection Screen Schedule in drawings.
6. Acceptable Product:
  - a. Da-Lite Tensioned Professional Electrol Series

## 2.12 VIDEO PROJECTORS

- A. Video Projector (PROJ, Type 1)
  1. Laser Projector
  2. Native Resolution: 4K UHD (3840 x 2160)
  3. Brightness 20,000 lumens
  4. Control Communication RS-232C
  5. Field verify throw distance to determine the appropriate lens
  6. Provide required lens
  7. Provide appropriate length pole
  8. Acceptable Product to include:
    - a. Epson EB-PQ2220B w/ Chief VCMU, Chief CMA110, and Chief CMS

## 2.13 AV SOURCES

- A. Wireless Presentation System (WPS, Type 1)
  1. Wirelessly Share Content from mobile devices
  2. 1U rack size
  3. Supports MS Windows, OSX as well as Apple and Android smartphones and tablets.
  4. Simultaneous display from up to 4 devices
  5. Moderator controlled.
  6. HDMI output
  7. USB Port
  8. Acceptable Product:
    - a. Mersive Solstice Pod Gen 3 Unlimited Enterprise, SP-8100-E5
- B. Digital Signage Player (DS, Type1)
  1. Standard I/O Player
  2. 8K video engine capable of decoding one 8Kp60 video.
  3. Gigabit Ethernet with PoE+, GPIO, IR, analog audio and an M.2 SSD PCIe interface.
  4. Acceptable Product:
    - a. Brightsign XT245

## 2.14 VIDEO SWITCHERS

- A. Audio/Video Presentation Switcher (DMPS, Type 1):
  1. Configurable 6x6 or 8x4 4K matrix switcher, scaler, audio power amplifier, and control processor
  2. Two configurable DTP3 or HDMI inputs
  3. Four dedicated HDMI inputs
  4. Two configurable DTP3 or HDMI outputs
  5. Two dedicated HDMI outputs
  6. Two configurable DTP3 inputs or outputs
  7. Integrated DTP inputs and outputs support transmission of video, control, and audio up to 330 feet (100 meters) over a shielded CATx cable
  8. 2RU height
  9. Acceptable Product:
    - a. Extron DTP3 CrossPoint 642 IPCP A LL (60-1661-12A)

## 2.15 TRANSMITTERS/RECEIVERS

- A. DTP3 Transmitter Wall Plate (DMTX, Type 1):
  - 1. Single HDMI input
  - 2. Decorator-Style Wall Plate
  - 3. Transmits HDMI up to 330 feet over a shielded CAT6A cable
  - 4. Coordinate color with architect.
  - 5. Acceptable Product:
    - a. Extron DTP3 T 101 D, Black (60-1902-52)
    - b. Extron DTP3 T 101 D, White (60-1902-53)
- B. DTP Receiver (DMRX, Type 1):
  - 1. Receives HDMI up to 330 feet over a shielded CATx cable
  - 2. Acceptable Product:
    - a. Extron DTP3 R 201 (60-1869-63)

## 2.16 USER INTERFACES

- A. Touch Panel (TP, Type 1):
  - 1. Screen size: 10-inch diagonal
  - 2. Capacitive touch surface
  - 3. Resolution: 1280 x 800
  - 4. PoE powered
  - 5. Wall Mount
  - 6. Acceptable Product:
    - a. Extron TLP Pro 1025M – Black (60-1566-02) w/Extron RM6 as required when rack mounted

## 2.17 AV NETWORK HARDWARE USER INTERFACES

- A. Network Switch (AV SWITCH, Type 1)
  - 1. Managed
  - 2. Gigabit switch
  - 3. PoE+
  - 4. Streaming compatible
  - 5. Acceptable Product:
    - a. Netgear M4250 Series
    - b. Packedge SX Series
    - c. Luxul AMS Series
    - d. QSC NS Gen-2 Series
    - e. Approved Equivalent

## 2.18 POWER SYSTEMS

- A. Power Sequencing
  - 1. Power Sequencing system to be operated via low voltage button contact closures from either push buttons located on panels local to the event space or via a contact closure from a relative control system (DSP, Control Processor, etc.)
  - 2. Devices to be sequenced “ON” in order of audio signal flow. Devices and equipment to be shut down in reverse order from “ON” sequence. Example “ON” order starting with:
    - a. Source devices. (Media Players, Pre-amplifiers, etc.)
    - b. Processing devices (DSP, Mixers, Video Switchers, etc.)
    - c. Output devices (Amplifiers, Powered Speakers, etc.)
  - 3. Devices not to be sequenced and to remain on for status and monitoring purposes to include but not limited to:
    - a. Network switches and components.

- b. Equipment housing ventilation systems.
  - c. Control system equipment responsible for providing control of Remote Power Sequencing system.
- B. Switched Power Distribution (SEQ, Type 2)
- 1. Low voltage-controlled power sequencer
  - 2. Rack mounted
  - 3. 6 controlled outlets
  - 4. 1 unswitched outlet
  - 5. Acceptable Product:
    - a. Middle Atlantic PDS-620R
- C. Rack Power Distribution (RPD, Type 1)
- 1. Modular raceway power system.
  - 2. Rack mountable vertical distribution.
  - 3. Low voltage contact closures.
  - 4. Coordinate wiring of high voltage components with electrical contractor.
  - 5. Provide additional raceways if circuit count exceeds maximum raceway length
  - 6. Coordinate wiring of high voltage components.
  - 7. Acceptable Product:
    - a. Middle Atlantic MPR-xA
      - 1) Middle Atlantic RLM-20A (Switched Module, as needed)
      - 2) Middle Atlantic RLM-30A (Switched Module, as needed)
      - 3) Middle Atlantic M-20A (Un-switched Module, as needed)
- D. Rack Power Distribution (RPD, Type 2)
- 1. Rack mountable vertical distribution.
  - 2. Used for additional outlets where needed.
  - 3. Size strip to number of required outlets.
  - 4. Acceptable Product:
    - a. Middle Atlantic PDT Series
    - b. Middle Atlantic PD Slim Series
- E. Power Protection with Lights (POWER/LIGHT):
- 1. 20 Amp power system.
  - 2. Eight switched AC outlets.
  - 3. Acceptable Product:
    - a. Furman Sound PL-PRO C
    - b. Approved Equivalent
- F. Power Protection with Lights (POWER/LIGHT):
- 1. For portable rack applications
  - 2. 15 Amp power system.
  - 3. Eight switched AC outlets.
  - 4. Acceptable Product:
    - a. Furman Sound PL-8C
    - b. Approved Equivalent
- G. Rackmount Uninterruptible Power Supply (UPS)
- 1. Provide UPS systems to maintain power to all networking and processing equipment, including digital audio mixer systems and recording equipment.
  - 2. UPS's shall be on-line style with sufficient battery reserve to operate for 15 minutes. Size each UPS unit for 25% additional capacity.
  - 3. Rack mountable.
  - 4. Acceptable Product:
    - a. Middle Atlantic Select Series UPS

b. APC Easy UPS Series

- H. Power Supplies:  
1. As required.

**2.19 EQUIPMENT HOUSING AND ACCESSORIES**

A. General

1. Refer to drawings for equipment rack sizes and additional notes.

B. Floor-Supported Wall Rack (Type 1)

1. Finish: Black powder coat
2. Tapped 10-32 rack rails
3. Acceptable Product:
  - a. Middle Atlantic SR series
    - 1) Middle Atlantic DWR-FK6 series
    - 2) Middle Atlantic LVFD series

C. Portable Equipment Rack (Type 1)

1. Size: 8RU front with 12RU Top
2. Tapped 10-32 rack rails
3. Acceptable Product:
  - a. SKB 1SKB19-R1208

D. Rack Blanks (BLANK)

1. Flanged, aluminum panel.
2. Anodized finish.
3. Acceptable product:
  - a. Middle Atlantic BL series

E. Rack Vents (VENT)

1. Flanged, aluminum panel.
2. Anodized finish.
3. Acceptable product:
  - a. Middle Atlantic VTP series

F. Cable Management

1. Brush grommet panel
2. Acceptable Product:
  - a. Middle Atlantic BR series

G. Rack Drawers (DRAWER)

1. Blank anodized finish
2. Acceptable product:
  - a. Middle Atlantic D series

H. Rack Mounted Sliding Shelf (SLIDE OUT SHELF)

1. Finish: Black
2. 1-RU rack mountable sizes.
3. Acceptable product to include:
  - a. Middle Atlantic SS

I. Equipment Rack Screws:

1. Install rack mounted equipment with black 10-32 star post security screws with flat nylon washers.

2. Quantity as required.
3. Provide one spare bit located in a clear plastic bag attached to the inside of each equipment rack in plain view.
4. Acceptable Product:
  - a. Middle Atlantic HTX

## 2.20 PLATES AND PANELS

- A. General
1. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.
  2. Custom panels shall be 1/8-inch thick aluminum, standard EIA sizes, brushed, anodized finish unless otherwise noted. Brush in direction of aluminum grain only.
  3. Plate finish shall be coordinated with the Owner. Plastic plates are not acceptable.
  4. Panel, plate and label engraving shall be 1/8-inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum pushbuttons, letters shall be black.
- B. Custom and/or Engraved Panels:
1. Custom panels constructed of 1/8 inch brushed aluminum
  2. Coordinate finishes with Owner
  3. Acceptable Manufacturers:
    - a. EMG
    - b. RCI Custom
    - c. ProCo
    - d. Radial Engineering

## 2.21 CONNECTORS

- A. XLR Panel mount Connectors
1. Provide panel mount XLR connectors with unified metal shell.
  2. RF-Protector connectors.
  3. Shell Color: Black.
  4. Contacts: Silver.
  5. Terminations: Solder.
  6. Acceptable Product:
    - a. Male Connectors: Neutrik NC\*MD-L-1-BAG Series
    - b. Female Connectors: Neutrik NC\*FD-L-1-BAG Series
- B. XLR Cable Connectors
1. Provide XLR cable connectors with die cast shell.
  2. No-screw type assembly.
  3. Chuck-type strain relief.
  4. Shell Color: Black.
  5. Contacts: Silver.
  6. Terminations: Solder.
  7. Acceptable Product:
    - a. Male Connectors: Neutrik NC\*MX-BAG Series
    - b. Female Connectors: Neutrik NC\*FX-BAG Series
- C. RCA Panel Mount Connectors
1. Provide panel mount RCA connectors with unified metal shell.
  2. RF-Protector connectors.
  3. Shell Color: Black.
  4. Terminations: Solder.

5. Acceptable Product:
  - a. Neutrik NF2D series
  
- D. 3.5mm Stereo Panel Mount Connectors
  1. Provide panel mount 3.5mm connectors with unified metal shell.
  2. RF-Protector connectors.
  3. Shell Color: Black.
  4. Terminations: Solder.
  5. Acceptable Product:
    - a. Switchcraft EH35MMMSCB
  
- E. Speaker Connectors
  1. Provide 4 or 8 conductor connector
  2. Shell Color: Black
  3. Terminations: Solder or tab
  4. Acceptable Product:
    - a. Neutrik NL4MPXX
    - b. Neutrik NL8MPRXX
  
- F. BNC Cable Connectors
  1. Provide cable mount BNC connectors.
  2. Contacts: Brass or copper.
  3. Terminations: Crimp.
  4. Acceptable Product:
    - a. Kings
    - b. Amp
    - c. Amphenol
    - d. Canare
    - e. Liberty
  
- G. HDMI Connectors
  1. Provide panel mount HDMI feedthrough connectors
  2. HDMI 2.0 compliant
  3. Acceptable Product:
    - a. Neutrik NAHDMI-W
  
- H. Ethercon CAT6 Panel Connectors
  1. Provide panel mount Ethercon CAT6 connectors
  2. Metal housing
  3. Shielded
  4. Acceptable Product:
    - a. Neutrik NE8FDP-B

## 2.22 LOOSE CABLES

- A. Microphone/Instrument Cables:
  1. Cable properties:
    - a. Quad 24 gauge stranded with braided shield, flexible hard service jacket.
    - b. Color: Black
    - c. Each cable to be provided with a Velcro style tie wrap.
      - 1) Minimum 5/8" width
      - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
      - 3) Standard of performance:
        - a) Rip-Tie CABLEWRAP
  2. Microphone Cable:

- a. Type 06 – 6 foot, with Gray collar on connector
  - b. Type 25 – 25 foot, with Blue collar on connector
  - c. Type 50 – 50 foot, with Green collar on connector
  - d. Type 100 – 100 foot, with Red collar on connector
3. Instrument Cable
- a. Type 06 - 6 foot, 1/4-1/4
  - b. Type 10 – 10 foot, 1/4-1/4
4. Acceptable cable:
- a. Whirlwind MKQ series
  - b. Canare StarQuad
  - c. ProCo AmeriQuad
- B. Speaker Cables:
1. Cable properties:
- a. Color: Black,
  - b. Connector: NL4 to NL4 or NL8 to NL8
  - c. Wire: 12 gauge stranded, SJ jacket.
  - d. Each cable to be provided with a Velcro style tie wrap.
    - 1) Minimum 1" width
    - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-18 inch diameter.
    - 3) Standard of performance:
      - a) Rip-Tie CABLEWRAP
2. Speaker Cable:
- a. Type 06 – 6 foot, with Gray collar on connector
  - b. Type 25 – 25 foot, with Blue collar on connector
  - c. Type 50 – 50 foot, with Green collar on connector
  - d. Type 100 – 100 foot, with Red collar on connector
3. Acceptable cable:
- a. Whirlwind NL series
  - b. Approved Equivalent
- C. Ethernet Audio Cables:
1. Cable properties:
- a. Color: Black
  - b. Neutrik Ethercon Connector
  - c. Rugged Tactical Jacket
  - d. Each cable to be provided with a Velcro style tie wrap.
    - 1) Minimum 5/8" width
    - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
    - 3) Standard of performance:
      - a) Rip-Tie CABLEWRAP
2. Ethernet Cable:
- a. Type 06 – 6 foot, with Gray collar on connector
  - b. Type 25 – 25 foot, with Blue collar on connector
  - c. Type 50 – 55 foot, with Green collar on connector
  - d. Type 100 – 100 foot, with Red collar on connector
3. Acceptable cable:
- a. ProCo DuraCat
  - b. Approved Equivalent
- D. Power Extension Cables:
1. Cable properties:
- a. Color: Black
  - b. 12-gauge, 3 conductor, stranded, flexible hard service jacket.

- c. Each cable to be provided with a Velcro style tie wrap.
  - 1) Minimum 1" width
  - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-18 inch diameter.
  - 3) Standard of performance:
    - a) Rip-Tie CABLEWRAP
2. Power Extension Cable:
  - a. Type 12 – 12 foot,
  - b. Type 25 – 25 foot,
  - c. Type 50 – 50 foot,
  - d. Type 100 – 100 foot
3. Acceptable cable:
  - a. ProCo E-Cords series
  - b. Approved Equivalent

## 2.23 INSTALLED CABLES & WIRING

### A. General

1. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.)
2. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
3. Where cables are routed through cable tray, provide tray rated cable of equal specification.
4. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
5. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
6. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from West Penn, Windy City Wire, Liberty, Commscope and Gepco are also acceptable provided they meet the performance specifications of the approved listed cables.

### B. Microphone/Line Level Wire

1. Provide shielded 22 AWG cable.
2. Cable to be PVC jacketed.
3. Jacket color: black.
4. Acceptable Product:
  - a. Belden 9451

### C. Speaker Level Wire

1. For applications less than 300W and/or 300 feet
2. Provide 16 AWG cable.
3. Cable to be CL3R or CL2P rated.
4. Jacket color: gray.
5. Acceptable Product:
  - a. Belden 5200UE

### D. Category Cable

1. 23-gauge solid cable
2. Category 6+ Enhanced
3. 4 pair, UTP
4. Acceptable Product
  - a. Belden 2412F



- E. Relay/Control Level Wire
  - 1. Provide unshielded 22 AWG cable.
  - 2. Cable to be CMR or CMP rated.
  - 3. Provide number of conductors where required.
  - 4. Acceptable Product:
    - a. Belden Cable
  
- F. Wireless /Assisted Listening Antenna Cable
  - 1. For applications less than 100 feet
  - 2. 16-gauge, stranded center conductor
  - 3. RG8/X
  - 4. 95% braided shield
  - 5. Acceptable Product:
    - a. Belden 9258
  
- G. HDMI Cable
  - 1. Provide pre-molded cables in lengths as required
  - 2. Acceptable Product:
    - a. Crestron® Certified HDMI® Interface Cable
    - b. Extron Ultra Series HDMI Cable
    - c. Comprehensive Microflex Pro AV/IT 18Gbps
  
- H. Digital Media Cable
  - 1. Shielded Twisted Pair Cable for XTP Systems and DTP Systems
  - 2. Enables lossless distribution of 4K and Ultra HD video signals at distances of 330 ft (100 m) via XTP and DTP
  - 3. CMR rated for non-plenum applications
  - 4. CMP rated for plenum applications
  - 5. Color: Black
  - 6. Acceptable Product:
    - a. Extron XTP DTP 24
    - b. Extron XTP DTP 24P (where required)

## 2.24 MISCELLANEOUS

- A. Desktop Light: (Type 1)
  - 1. 12" LED gooseneck light
  - 2. On/off switch
  - 3. Weighted base
  - 4. Acceptable Product:
    - a. Littlite LW-12-LED
  
- B. Headphones (Type 1):
  - 1. Acceptable Product:
    - a. Sony MDR-7506
    - b. Shure SRH440
    - c. Approved Equivalent
  
- C. Mobile Cabinet: (Type 1) – Microphones / Accessories
  - 1. Lockable
  - 2. Steel construction
  - 3. 4 Drawers
  - 4. Large 6" casters
  - 5. Acceptable Product:
    - a. Westward 3401NVS-5PU-95W
    - b. Approved Equivalent

- D. Mobile Cabinet: (Type 1) - Speakers / Cables
  - 1. Lockable
  - 2. Steel mesh construction
  - 3. Large 6" casters
  - 4. Double doors
  - 5. Acceptable Product:
    - a. Grainger 9WMJ8
    - b. Approved Equivalent

### **PART 3 - EXECUTION**

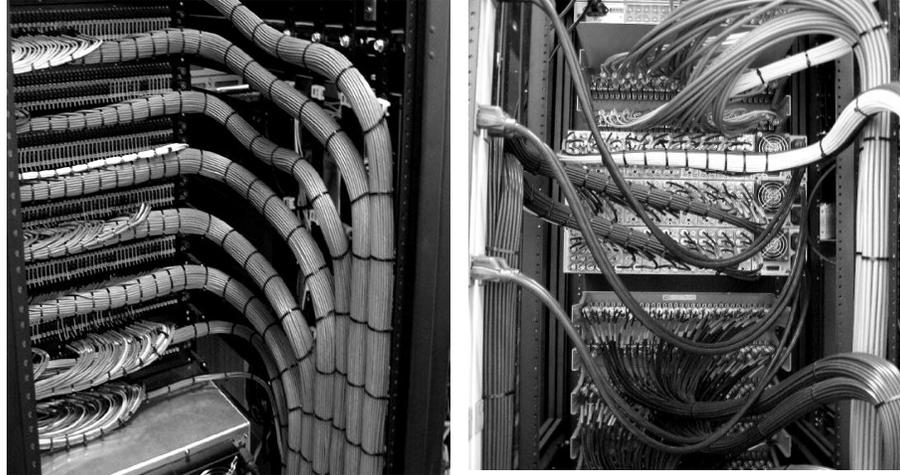
#### **3.1 GENERAL**

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final Products.
- B. The installation recommendations contained within ASDI and Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
- C. Mount equipment and enclosures plumb and level.
- D. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.
- E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

#### **3.2 INSTALLATION**

- A. Installation of cable and wiring
  - 1. Cabling and Wiring:
    - a. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and restrictions.
    - b. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
    - c. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
    - d. Horizontal distribution cables shall be bundled in groups of no more than 50 cables when being supported by J-Hook or trapeze systems. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance. An exception to this rule is when cable is installed in cable tray systems.
    - e. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices
    - f. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
    - g. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.
    - h. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The

- cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- i. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
  - j. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.
  - k. Make joints and connections with rosin-core 60/40 solder or with mechanical connectors specifically intended for the type and class of cable being used. Where spade lugs are used, crimp properly with ratchet type tool.
  - l. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at one end. Shield not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.
  - m. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.
  - n. Connect cable to active components through XLR connections whenever multiple formats are available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
  - o. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
  - p. Execute wiring in strict adherence to:
    - 1) Phillip Giddings. Audio System Design and Installation. Indianapolis: Howard W. Sams & Co., 1990.
    - 2) Don Davis and Carolyn Davis. Appendix II, Recommended Wiring Practices. Sound System Engineering, 2nd Edition. Indianapolis: Howard W. Sams & Co., 1989.
    - 3) AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm, 2009
2. Equipment Housing Cabling and Wiring:
- a. Lace, tie, or harness wire or cable as required herein, and in accordance with accepted professional practice. Dress, lace or harness all wire or cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Reference photos below for standard of quality.



- b. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.
  - c. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
  - d. Provide plastic cable ties or Velcro straps to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
  - e. Install with connections completely visible and labeled.
  - f. Provide termination resistors, if required, of 5 per cent tolerance; fully visible and not concealed.
- B. Installation of connectors, plates & panels:
- 1. Install panel mounted connectors rigidly attached to panels, plumb and level.
  - 2. Custom rack panels shall be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish (brushed in direction of aluminum grain only), unless otherwise noted.
  - 3. Custom connector plates (speaker, microphone, etc.) are typically stainless steel, unless otherwise noted or specified. However, verify plate finish with Architect.
  - 4. Install XLR type connectors in accordance with IEC-268 standard, with a wiring scheme of pin 2 hot (high), pin 3 (low), and pin 1 screen (shield).
  - 5. Other Plates and Panels may be required to satisfy the requirements of the Work.
- C. Installation power and grounding:
- 1. Coordinate final connection of power and ground wiring to housings.
  - 2. Hardwire power wiring directly to internal AC receptacles to ensure uninterrupted operation.
  - 3. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing. Provide a minimum of two spare outlets in each rack.
  - 4. Provide a copper ground buss top to bottom in each housing, insulated from the housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.
  - 5. Replace manufacturers supplied 18 gauge IEC power cords with UL listed 18 gauge pre-molded 6", 12", 18", or 24". Use minimum length required. No looped or cable tied IEC power cords will be permitted within the equipment rack.
  - 6. Replace manufacturers supplied 14 gauge IEC power cords with UL listed 14 gauge pre-molded 18" or 36" for all equipment IEC capable. Use minimum length required and minimize looped or cable tied IEC power cords present in the equipment rack.
- D. Installation of electronic equipment:

1. Take appropriate precautions against electrostatic discharge (ESD). Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
  2. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.
  3. Mount trim potentiometers, custom circuit cards, relays, and transformers (except large 70V units) in shielded enclosures, and mark their function and connections with engraved lamicoid labels.
  4. Mount equipment plumb and level, firmly and safely held in place.
- E. Installation of equipment housing:
1. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner in writing that racks will be fabricated on site and the reasons for the change.
  2. Secure rack mounted devices utilizing all available fastener mounting positions on device.
  3. Provide rear support for housing mounted equipment greater than 15 inches deep.
  4. Provide blank panels to fill unused panel space within the equipment housing.
  5. If Key door locks are required, key each housing type alike.
  6. Looking at the rack from the rear, locate AC power and speaker wiring on the left; line level audio, video, and RF wiring on the right.
  7. Provide shaft locks or security covers on non-user operated equipment having front panel controls. These panels are to be installed at the conclusion of testing.
  8. If forced air active thermal management is used, provide ventilation blocking material on the front, sides, and rear of the equipment rack as needed. Reference Middle Atlantic Products "Controlling the Temperature Inside Equipment Racks".
  9. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.
  10. If equipment rack is not equipped with casters, provide two inch high wood base to isolate equipment rack from floor. Wood base should be capable of supporting the load.
- F. Installation of loudspeakers:
1. The Contractor is responsible for final design and engineering of loudspeaker rigging, attachments, brackets, and hoisting.
  2. Loudspeakers shall be mounted at the operating position in a safe, secure, and permanent manner.
  3. Provide custom rigging as needed.
  4. Suspension and Mounting:
    - a. Static and dynamic equipment loads shall be suspended or mounted in compliance with the following ANSI/ESTA standards, using the latest available versions of the standards:
      - 1) ANSI E1.4-2-2021 Statically Suspended Rigging Systems
      - 2) ANSI E1.56-2018 Rigging Support Points
      - 3) ANSI E1.6-1-2021 Powered Hoist Systems
      - 4) ANSI E1.8-2012 Loudspeaker Enclosures Intended for Overhead Suspension
    - b. Rigging, mounting, and support systems for overhead suspended loudspeakers shall be reviewed and certified by a registered Professional Engineer (PE), in the employ of the Contractor, licensed to practice in the State in which the project is located. Documentation shall be included as a submittal item. Once the systems are installed, the PE shall physically inspect, at the Contractor's cost, the methods and means used to verify compliance with the original design.
  5. General Guidelines:
    - a. Paint loudspeakers, supports, and related hardware color as directed by the Owner.

- b. The aiming direction of all loudspeakers shall be adjustable by no less than  $\pm 5$  degrees horizontally and vertically.
  - c. Loudspeakers are to be oriented parallel to their mounting surface unless otherwise noted.
  - d. Provide a safety cable connected to a secondary location for each loudspeaker.
  - e. All loudspeakers located in ceiling tiles shall be located in the center of the tile unless noted otherwise.
  - f. Paint loudspeakers to match surroundings. Confirm color selection with the Architect during the submittal phase.
  - g. Exterior loudspeaker cabinets shall be constructed of materials designed for permanent outdoor exposure conditions with a minimum IP 54 rating, and a minimum expected 10-year life span. Exterior and interior surfaces of the cabinets shall be protected from the effects of water, moisture, and humidity. The exterior surface shall also be protected from the effects of ultraviolet radiation to prevent fading and color change. The cabinets shall be shaped and oriented in a manner that minimizes the possibility of water pooling on any cabinet surface. Associated hardware shall be inherently non-corrosive, performing to the standards of 304 Stainless Steel or higher.
- G. Installation of projectors:
- 1. Confirm distance of specified projection lens before mounting projector.
  - 2. Projectors shall be mounted plumb and level at the operating position in a safe, secure and permanent manner.
  - 3. All hardware required to locate the mount and projector at the required location shall be provided.
  - 4. Projectors shall be mounted using tamper proof secure hardware.
  - 5. Contractor may be required to adjust projection screen and lift upper and lower limit switches for projection screens and lifts specified elsewhere and not installed as part of this Contract.
- H. Installation of flat panel monitors:
- 1. Confirm location before mounting.
  - 2. Monitors shall be mounted plumb and level at the operating position in a safe, secure and permanent manner.
  - 3. All hardware required to locate the mount and monitor at the required position shall be provided.
  - 4. Locate monitor on the center line of the room unless noted otherwise.
- I. Loose Equipment
- 1. Provide loose equipment as indicated on drawings.
  - 2. Unpackage and assemble items.
  - 3. Place items in designated storage or refer to Owner for direction on final location and storage of loose equipment.

### 3.3 FIRESTOP

- A. A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire-stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.
- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped.

- C. Fire-stop systems shall be reviewed by a Professional Engineer (PE) licensed to practice in the State in which the project is located. Stamped drawings showing the fire stop systems shall be included as a submittal item. Once the systems are installed, the engineer of record for the firestop system shall physically inspect the methods and means used to verify compliance with the original design.
- D. A drawing showing the proposed fire-stop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the fire-stop system(s).
- E. All fire-stop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for observation by the local authorities prior to cable system acceptance.

### 3.4 CONTROL SYSTEM PROGRAMMING

- A. General
  - 1. Audio level controls
    - a. Audio level controls to use UP/DOWN buttons to change audio levels in 2 dB increments (or closest translation by control system).
    - b. Microphone and line level controls to have a fixed range between 0 and -24 dB.
    - c. Audio outputs/zone output level controls to have a fixed range between 0 and -6 dB.
    - d. Provide visual feedback of current level setting.
    - e. Provide additional level control upstream of user-level control to set the overall level for each zone.
  - 2. Audio System with power sequencing definitions:
    - a. STANDBY: System is powered on with all outputs muted in processing.
    - b. MODE: See individual systems for exact routing in each mode. System is on and outputs are unmuted in processing.
    - c. OFF: System is powered down with all outputs muted in processing.
- B. Cafeteria
  - 1. Low voltage controls for AV control system
    - a. Power Sequencing
      - 1) Power Up: Triggered via touch panel
        - a) SYSTEM ON: Control system to begin System Power Up Sequence. Sequence to be timed to trigger sequencing systems in accordance with the sequence specified in Power Sequencing Systems in this specification. During sequence, Control System to flash the SYSTEM STANDBY indicator located on touch panels until sequence is complete. Upon completion, Control System to indicate that the system is powered on and ready via solid color or state on SYSTEM STANDBY indicators on touch panels.
      - 2) Power Down: Triggered via touch panels
        - a) SYSTEM OFF, Control system to begin System Power Down Sequence. Sequence to be timed to trigger sequencing systems in accordance with the sequence specified in Power Sequencing Systems in this specification. During sequence, Control System to flash the SYSTEM OFF button on touch panels until sequence is complete. Upon completion, Control System to indicate that the system is powered off by solid color or state on SYSTEM OFF indicator on touch panels. All other touch panels to indicate system is off and where to turn the system on.
  - 2. Low-voltage/network controls for DSP
    - a. Page/Fire Alarm

- 1) Triggered by the paging and/or fire alarm system, this preset to change the Source Matrix to mute.
3. DSP functions triggered by AV Control System touch panels
  - a. STANDBY: Audio DSP preset to mute all output capability of the system. AV Control System to un-route all video signals, power off all displays and projector(s), and retract projection screen(s.)
  - b. EVENT: This preset to change Audio DSP Source Matrix to route the outputs of the digital mixing system to the main loudspeakers. All outputs of the DSP to be unmuted. AV Control system to power on all displays with no video routed. Video routing will be done manually.
  - c. PRESENTATION: This preset to change Source Matrix to route the outputs of the stage mixer to the main loudspeakers. Audio feeds to the Back-of-House Corridors, Talent Spaces, and any feeds to adjacent spaces not supporting the Cafeteria to be muted. AV Control system to only provide video switching to displays within the Auditorium and the Lobby.
    - 1) Volume controls: Provide volume controls for sources shown in DSP diagram.
    - 2) Mute controls: Provide mute buttons for sources shown in DSP diagram.
  - d. CHOIR: This preset to disable the first row of speakers above the stage, allowing for choir performances that require the stairs in front of the stage to be in use.
- C. Transport Control
  1. Provide standard Stop, Play, Pause, Fast Forward and Rewind for each playback device and menu control for DVD players. Buttons should be arranged in a conventional fashion that will be familiar to the normal user.
  2. The selected control function should be displayed by showing the appropriate button "pressed". It should remain this way until another function is selected.
  3. For devices that will go into a standby mode after a period of time, the control system shall sense this mode and restore normal operating mode once a transport function has been selected. This may require the use of current sensors to determine the state of the unit. No direct user action should be required at the playback device to restore the normal operating mode.
- D. Screen/Shade Control
  1. In addition to up-down functions, provide a Stop function to allow the movement to be halted. Once movement has been stopped, the up or down buttons should resume travel in the selected direction.
  2. Control system shall not prevent screen/shade wall controls from being used as well.
  3. Touch panel controls should be readily accessible to the user to permit direct control of shades or screen with having to navigate through multiple control pages.
- E. Volume Mute
  1. Where the ability to mute the sound is needed, the button shall use the label "Vol On" and "VOL OFF" instead of Mute and Unmute. When in a "VOL OFF" mode, pushing the "VOL UP" button shall restore the sound and bring the system out of the muted mode.
  2. VOL ON/OFF buttons shall change color to indicate the status of the button.
- F. Standard Colors
  1. Control functions shall be color coded to add clarity and show relationships between different groups of controls.
  2. The color Red shall be reserved to indicate a fault or abnormal condition.
  3. Green may be used to indicate normal operation, but may be used for standard control colors as well.
  4. Similar controls should maintain the same color scheme across all control pages.
  5. When a function is selected, the graphical depiction of that button should appear to be pressed and its color change to a darker shade of the regular button color.



6. Color schemes used for background and foreground objects should be selected to be complimentary and provide a consistent theme throughout the control pages.
- G. Minimum Button Size and Placement
1. Minimum visual size of a button is 3/8" wide by 1/4" high.
  2. Spacing between buttons should be no less than 1/16".
  3. Where buttons are immediately adjacent, the active selection area of the button should be reduced to 80% of the visual area of the button.
- H. Button Actions
1. When a function on a control page is selected, that button or visual object associated with that function should change to reflect what has been chosen.
  2. For functions that are momentary selections (i.e., VOL UP), the change of state is visible for as long as the button is being pressed.
  3. For function that are maintained selections (i.e., PLAY), the change of state remains visible until another function is selected and resets the previous function.
  4. The state change of a button or visible object should depict real-world objects as much as possible including the appearance of the button be pressed inward, change in shade of the original color, but not a change in hue.
- I. Labels
1. Use of simple words or titles are preferred to indicate functionality, navigation and system status.
  2. Use of stylish symbols should be avoided unless their identity is commonly recognized by the general public. Standard symbols for transport functions are acceptable.
  3. Labels should be presented in a clear, sans serif type face that will remain legible on lower resolution touch panels.
  4. Where physical buttons are present along the side of a touch panel, these buttons should be engraved and filled with a contrasting color.
- J. Power On/Off
1. For panels requiring an ON/OFF control, these functions should be linked through current sensors or other methods for the control system to detect the power on condition of the component being controlled.
  2. Powering off a system should not interfere with the ability of a projector to complete its cool down cycle.
- K. Look & Feel
1. Control pages should utilize a clean, elegant but stylish appearance.
  2. Use a common graphical template across all control pages for a consistent look.
  3. The touch screen layout should utilize graphical elements such as drop shadows, gradient fills and transparency to provide a pleasing overall appearance.
  4. Utilize graphical representations of floor plans to convey location information.
  5. Include company logos, icons or watermarks to portray the corporate identity.
  6. Provide clear navigation tools for moving between control pages.
  7. Each sub-page should have a "BACK" button to return to the previous page. This button should appear in the same location on each page.
  8. Provide a "HELP" button or icon on each user page to provide clear, non-technical instructions on how to use the functions available to regular users.
- L. Security
1. Provide password access to control pages not intended to be accessed by the general public.
  2. Unless otherwise noted, provide a minimum of three levels of access
    - a. General User
    - b. Non-Technical Employee

- c. AV Technician
- 3. Segregate the control functions to only allow authorized individuals access to more sophisticated control pages.
- 4. Provide a timeout feature to automatically return the control panel back to the default opening screen after 30 seconds of inactivity. After this reset, passwords must be reentered to return to a previous control page.

M. Presets

- 1. For systems that have different operating modes or configurations, provide the ability to store and recall preset combinations of system settings.
- 2. Provide a "Preset" page that permits a minimum of five presets to be recalled. Each button to include a label describing the function or configuration associated with that button.
- 3. Provide the ability for new presets to be stored over previous settings. New preset to be able to change the label to reflect the new or revised configuration.
- 4. When a preset has been recalled, the control page should indicate the active configuration.

### 3.5 LABELING OF EQUIPMENT

- A. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on system schematic drawing.
- B. Provide logical and legible cable and wiring label permanently affixed for easy identification.
  - 1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
  - 2. Wiring designator to be an alpha-numeric code unique for each cable. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings.
  - 3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.

### 3.6 LABELING OF CABLES

- 1. Labels must conform with AVIXAF501.01:2015 Cable Labeling for Audiovisual Systems

### 3.7 ENGRAVING

- A. Text font: 1/8 inch block sans serif characters unless noted otherwise.
- B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.
- C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.
- D. Equipment label: black with white characters except where indicated.

### 3.8 COMMISSIONING

- A. Prior to energizing or testing the system, ensure the following:
  - 1. All products are installed in proper and safe manner according to manufacturer's instructions.
  - 2. Insulation and shrink tubing are present where required.
  - 3. Dust, debris, solder splatter, etc. is removed.

4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
  5. Labeling has been provided.
  6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
  7. Products are neat, clean and unmarred and parts securely attached.
  8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
- B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.
1. Electronic devices are properly grounded.
  2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
  3. Verify each individual component is operating properly.
  4. Verify each individual component's performance meets the manufacturer's published performance for this unit.
  5. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
- C. Speaker Circuit Verification Test
1. Measure the impedance of each speaker line leaving the equipment racks.
  2. For constant voltage systems measure the impedance at 100 (or 250) Hz, 1 KHz and 8 (or 10) KHz of each line leaving the equipment rack with the line disconnected from the driving source. For band limited devices, use a frequency appropriate for the operating range of the transducer.
  3. When documenting the results of these tests, include the calculated impedance based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20% from the calculated impedance.
  4. Include the results of the tests in the Project Record Manual.
- D. Speaker Polarity Verification Test
1. Use an electronic polarity checker, TEF-20, SYSID, SIM II, Smaart, or other similar device to test each loudspeaker. All speakers should have the same relative polarity.
  2. Follow manufacturer's recommendations in conducting the tests.
  3. Include the results of the tests in the Project Record Manual.
- E. Audio Signal Paths
1. Verify operation from each source device through all switching, amplification and distribution devices.
- F. System Gain Adjustment
1. Adjust each active device to have proper gain structure from the mixer output to the input of the amplifier.
  2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the mixer. Using an RMS AC voltmeter with a dB scale, adjust the mixer to an output between -10 and 0 dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
  3. Follow the signal flow from the mixer to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings exceed this range.
  4. Adjust the output of each component to achieve the proper output level.
  5. Record the output levels of each device in the Project Record Manual.

- G. Signal Delay Adjustment
1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and delayed speakers.
  2. Using a TEF 20, SYSID, Smaart, SIM II, or other acceptable time based measurement system, measure the arrival time of the distant signal and then measure the arrival of the local signal.
  3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1 ms of the arrival of the distant signal. Once the precise delay time has been determined, provide an additional 10 ms of Haas effect delay to maintain directional orientation toward the original sound source.
  4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
  5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.
- H. Remote Input Verification Test
1. Using a microphone or portable signal generator, connect to each microphone/line level receptacle throughout the facility.
  2. Verify that the receptacle under test appears at the correct input and is operating properly.
  3. In a similar manner, check all remote tielines and media related lines for correct wiring and labeling.
- I. System Equalization
1. Using a RTA, TEF 20, SYSID, or SMAART, equalize all loudspeaker systems to provide a suitable frequency response as follows:
    - a. Speech Reinforcement Systems: flat response from 125 Hz to 2.5 KHz, with 2 dB roll off above.
    - b. Program Reproduction Systems: flat response from 65 Hz to 8 KHz, with 2 dB roll off above.
  2. Verify system gain and amplifier levels.
  3. Provide program levels of at least 85 dB and speech reinforcement levels of at least 70 dB in the seating area without objectionable distortion, buzzes, or rattles.
  4. Provide hard copy printouts of the spectral response with the test data.
- J. RFI and Parasitic Oscillation
1. With systems operating check to ensure that all systems are free from spurious oscillation and radio frequency interference in the absence of audio signal.
- K. Buzzes, Rattles and other Distortions
1. Adjust the system for normal operating level in the space. Apply a slow sine wave sweep from 60 Hz to 3 KHz and listen carefully for buzzes, rattles and other objectionable distortions.
  2. Correct the cause of the defect. If the cause is not from the system. Bring the cause to the attention of the GC, indicating cause and suggestive corrective actions.
- L. Video Systems Test
1. Projected images and screen must be plumb with respect to ceiling line.
- M. Video System Tests. Verify performance of all video equipment, components and systems, as specified herein.
1. Video (signal):
    - a. S/N (peak to RMS), unweighted DC to 4.2 MHz: 55 dB minimum.
    - b. Crosstalk, unweighted DC to 4.2 MHz: 45 dB minimum.
    - c. Frequency Response: Within plus to minus 0.5 dB to 4.2 MHz.

- d. Line and Field Tilt: 2% maximum.
  - e. Differential Gain: 2% maximum.
  - f. Differential Phase: 2 degrees maximum.
  - g. Frequency Response: DC to 4.2 MHz within plus or minus 0.5 dB.
- N. Video Signal Paths
- 1. Verify operation from each source device through all switching, amplification and distribution devices.
- O. Video Test Report shall include the following:
- 1. Test Failures and Notices
    - a. Sink Device EDID Test – Open items or failures shall not be accepted.
    - b. Cable Length Test – Open items or failures shall not be accepted.
    - c. HDCP KSV Limitations – Limitations shall not be accepted.
    - d. Cable Limitations - Limitations shall not be accepted.
    - e. EDID Limitations - Limitations shall not be accepted.
    - f. Cable Length Limits exceeded – Failing cables shall not be accepted.
  - 2. Device Model Number, Serial Number, and Firmware Version for main chassis and each input and output card.
  - 3. Device Model Number, Serial Number, and Firmware Version for connected transmitter and receiver devices.
  - 4. EDID – Input Resolution and 3D support status for each input.
  - 5. EDID – Supported Output Resolution and 3D support status for devices connected to each output.
  - 6. EDID – Supported Audio formats for each input.
  - 7. EDID – Supported Audio formats for devices connected to each output.
- P. Control Systems
- 1. Verify operational functions of the control system and all interfaced devices.
  - 2. Verify operational functionality of any wireless user devices.

### 3.9 CAT5E/CAT6 CABLE CERTIFICATION

- A. General Field Test Requirements
- 1. All CAT5E/CAT6 cabling links installed as part of this scope shall be tested for the following, in accordance with the field test specifications defines in ANSI/TIA-568-C.2 “Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard.” This document will be referred to as the “Category 5e Standard”:
    - a. Wire Map
    - b. Length
    - c. Insertion Loss
    - d. NEXT loss
    - e. PS NEXT Loss
    - f. ACR-F Loss
    - g. PS ACR-F Loss
    - h. Return Loss
    - i. Propagation Loss
    - j. Delay Skew
  - 2. The installed twisted-pair horizontal links shall be tested from terminated end point to terminated end point for compliance with the “Permanent Link” performance specification as defined in the Category 5e Standard.
  - 3. One hundred percent of the installed cabling links must pass the requirements of the Category 5e standard mentioned above and as further detailed in Section B below. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final

and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section C below.

4. The test equipment (tester) shall comply with the accuracy requirements for level IIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 2 of ANSI/TIA-1152 (Table 2 in this TIA document also specifies the accuracy requirements for the channel configuration).
5. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. The Pass or Fail condition of the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specifies test limits for that parameter.

B. Performance Test Parameters

1. The test parameters are defined by the Category 5e Standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 100 MHz) must meet or exceed the limit value determined in the above mentioned standard.
2. Wire Map - Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct.
3. Length – The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
4. Insertion Loss (Attenuation) – Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 100 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk Ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results of the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which the worst case value occurs, and the test limit value at this frequency.
5. NEXT Loss – Pair-to-pair near end crosstalk loss (abbreviated as NEXT loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 100 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT loss measurements shall not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results):

Identify the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Table 1 – Maximum frequency step size as defined in ANSI/TIA-1152

Frequency Range (MHz)	Maximum Step size (MHz)
1 - 31.25	0.15
31.26 - 100	0.25

6. PS NEXT Loss – Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 100 MHz and the step size may not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Maximum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS next. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
7. ACR-F Loss, pair to pair – Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured 1 through 100 MHz and the maximum step size for FEXT loss measurements shall not exceed the maximum step size defined as the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value for ACR-F. There wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
8. PS ACR-F Loss – Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs of the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
9. Return Loss – Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst value of Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
10. Propagation Delay – Propagation delay is the time required for the signal to travel from one of the links to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

11. Delay Skew – [as defined in the Category 5e Standard; Section 6.2.19] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

C. Test Result Documentation

1. The test results/measurements shall be transferred into a Windows based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
2. The database for the completed job shall be stored and delivered on CD-ROM or DVD including the software tools required to view, inspect, and print any selection of test reports.
3. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
  - a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
  - b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
  - c. The date and time the test results were saved in the memory of the tester.
4. General information to be provided in the electronic data base with the test results information for each link:
  - a. The identification of the customer site as specified by the end-user.
  - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
  - c. The overall Pass/Fail evaluation of the link-under-test
  - d. The name of the test limit selected to execute the stored test results
  - e. The cable type and value of NVP used for length calculations
  - f. The date and time the test results were saved in the memory of the tester
  - g. The brand name, model, and serial number of the tester.
  - h. The identification of the tester interface
  - i. The revision of the tester software and the revision of the test limits database in the tester
  - j. The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C5.
5. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
6. The detailed test results data to be provided in the electronic database must contain the following information:
  - a. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m330 and test limit value.
  - b. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
  - c. Delay Skew: Identify the pair with the largest value for delay skew, the value measured in nanoseconds (ns) and the test limit value.
  - d. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair.



- e. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
- f. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.
- g. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.

### **3.10 FINAL OBSERVATION & TESTING**

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final observation and test will be performed by the Owner or Owner's representative no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
  - 1. Observation of the methods and means employed to incorporate the System within the facility.
  - 2. Verification of proper operation, from controlling devices to controlled devices.
  - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
  - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

### **3.11 TEST EQUIPMENT**

- A. Thirty days prior to start of testing, provide a list to the Owner of test equipment make, model numbers and calibration dates that will be used.
- B. The following equipment shall be available on site for the entire test period through final system testing.
  - 1. Sound Level Meter : ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
  - 2. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz,  $\pm 1$  dB (long-term average) at 0 dBm output. Stability:  $\pm 2$  dB per day.
  - 3. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
  - 4. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 5k Hz. Measurement Range: 1 ohm to 100 kohms.

5. Audio Oscillator: bandwidth 20 Hz to 20k Hz  $\pm$ 5 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level over the range from  $-30$  dBu to  $+10$  dBu.
  6. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V, 10 ma to 10 A, dB.
  7. NTSC Test generator
  8. Real time analyzer with LED or CRT display. The unit shall meet the filter requirements of ANSI S1.11 Class III for one third octave filters.
  9. Video (analog) test generator capable of generating signal up to 1920 x 1200 with audio.
  10. Video (digital) test generator capable of generating signal up to 1920 x 1200 with audio.
  11. Ladders and scaffolding necessary to inspect elevated equipment, junction boxes, etc.
- C. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and recharger along with holster for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

### **3.12 INSTRUCTION OF OWNER PERSONNEL**

- A. Provide instruction to Owner designated personnel focusing on the use, operation and maintenance of the systems, scheduled as a minimum of two separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction. Coordinate schedule of demonstration with Owner's Representative.
1. Cafeteria
    - a. 4 hours of instruction
- B. Video record all training sessions and compile a training video to be provided to the Owner on DVD.
- C. Provide sign in sheet to document the attendee's presence.
- D. If Contractor is not properly equipped to conduct Owner training on particular equipment, arrange for factory representatives of the equipment to be present to provide training at no additional cost to the Owner.

### **3.13 CLEANUP AND REPAIR**

- A. Upon completion of the work, remove refuse and rubbish from and about the premises. Leave areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation of systems at no cost to the Owner.

**END OF SECTION 27 41 16**

## **SECTION 27 51 23 – INTEGRATED ELECTRONIC COMMUNICATIONS AND CLOCK NETWORK**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. The drawings and general provisions of the Contract Documents apply to this Section.
- B. Section 27 00 00 – BASIC MATERIALS AND METHODS

#### **1.2 SUMMARY**

- A. Provide a complete communications system capable of providing two-way speech communication between selected speaker stations or intercom handsets and main console. System shall also be capable of distributing sound and voice signals to all system speakers simultaneously or in user programmed groups of speaker stations.
  - 1. High School and Middle School classrooms shall have a speaker and a call button. Elementary School classrooms shall have an intercom speaker only. Call button to be Rauland Model #603302.
  - 2. All portable classrooms (A and B sides) shall be updated with IP speakers, call buttons and a Lock Down button. Call Buttons in High Schools and Middle Schools only. Re-use existing call button and lock down button locations in portables.
  - 3. Reception desk and designated offices shall have Console Phones.
  - 4. All offices shall have a volume control for speakers.
- B. Lock Down Buttons
  - 1. See Division 28 Section 9 of these Construction Standards for requirements and wiring standards.
- C. Fire Alarm System Interconnection: APPLICABLE IN HIGH SCHOOLS AND IN MIDDLE SCHOOLS - Main communications and local sound reinforcement systems in the Gymnasiums, Cafeteria, Natatorium, Black Box and Large Group Instruction shall be automatically muted during fire alarm system activation (NFPA Life Safety Code 101, 7-6.3.10 and National Fire Alarm Code 72, 3-8.13.5). However, school communication system shall remain capable of manual override so that school staff can deliver voice instructions over the school communications system, such as directing students to return after a fire drill.
- D. The system shall be supplied by the manufacturer's authorized contractor, Rauland, Certification shall be submitted verifying that the contractor is the manufacturer's authorized contractor. Included shall be certificates of attendance in manufacturer's installation / maintenance training by the contractors directly employed personnel. The communications contracting company shall have been in business for a minimum of 5 years, continuously furnishing the specified manufacturers' product lines and systems.
- E. The system assemblies shall be completely factory built and tested by manufacturers of established reputation, who have and can refer to similar systems which are currently installed and functioning properly. The factory pre-assembled cabinets, consoles, and power supplies shall be UL approved and listed.
- F. The system shall be guaranteed for a period of five years from the date of acceptance or first beneficial use, whichever is first, against defects in materials, workmanship, design and improper adjustment. Any defects in the system shall be corrected at no expense to the Owner, provided

the system does not show signs of abuse. During the guarantee period any work found not to be in conformance with the plans, specifications and addenda shall be brought into conformity with same at no additional cost to the owner.

- G. The equipment furnished shall be supplied by one communications contractor. The contractor shall hold the necessary License for this type of work. Contractor is required to submit current certification from manufacturer with submittals.
- H. Provide local wall mounted volume control in all offices, work rooms, conference rooms, teaching theaters, large teaching areas, special needs classrooms, band, orchestra and choir and all practice rooms. Provide volume control at intercom/P.A. rack for auditorium all dressing rooms and corridors around auditorium, cafeteria, and corridor circuits for Middle and High Schools.
- I. Provide call in switch on wall closest to door leading to hallway in Middle and High Schools. Button to be Rauland model #603302. Red EMERGENCY and white NORMAL call in
- J. Provide IP admin phone and microphone at receptionist, principal's office, AP secretary, all AP's and any admin suite.
- K. ADDITIONS/RENOVATIONS (Existing buildings w/analog recording).
  - 1. Maintain a fully functioning system in unaffected areas.
  - 2. Remove all abandoned equipment and return to owner, remove all abandoned wiring and patch surfaces at wall and floor penetrations.
  - 3. Maintain access to all existing equipment.
  - 4. Prior to construction, a system test will be required of the contractor to demonstrate the current state of the system. Any non-functioning item at this time shall be noted and addressed by CFISD maintenance. If system is proven to be 100% functional, the contractor is responsible to any repair necessary to return it to its previous state.
  - 5. At Substantial Completion or when system is ready to be tested, a demonstration is required by the contractor to demonstrate the system mirrors the system condition prior to construction. If system is not functioning the same prior to construction, the contractor shall make necessary repairs to bring the system back up to the pre-construction condition.
- L. This section includes a fully operational IP platform for a district-wide internal and school Critical Communications Solution, school safety notifications and general communications including but not limited to the following:
  - 1. The platform shall provide complete internal communications and employ state of the art IP Technology including the minimum functions listed.
    - a. Two-way internal intercommunications between staff locations and classrooms.
    - b. Scheduled bell events.
    - c. Emergency announcements that will override any pre-programmed audio, assuring that all Emergency/Lockdown etc., are heard at each and every speaker location.
    - d. Capability of prerecording emergency announcements that can be activated by a Soft Key on an administrative console, panic button, dial string, or web browser.
    - e. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
    - f. District-wide, Emergency, Group, All School and Zone live voice paging.
    - g. District-wide, Emergency, Group, All School and Zone paging for pre-recorded audio – tones, music and voice.
    - h. Web-based user interface.
  - 2. The system shall support a minimum of 1000 level priorities which shall be user-definable, allowing each end point to place a minimum of 5 different priority calls at the same time.
  - 3. Any authorized administrator shall be able to call from outside the school into any classroom, zone, or entire school directly via the School District supplied SIP enabled

Telephone Network. This shall allow remote monitoring, call-in annunciation, and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools).

4. Authorized system users shall be able to create a minimum of 100 automated sequences with voice instructions, tones, emails, program distribution, and relay activations and replay them.
5. Automated message strings shall be manually initiated from a single-button access on the console, on a SIP connected telephone, a panic button, from the web-based user interface or via interface with third party systems.
6. Paging and two-way intercom features shall be accessible from any system console or SIP connected telephone for each campus.
7. The platform shall synchronize its system time to the network timeserver or a web-based time server.
8. Each single campus installation shall be locally survivable for intercom, paging, bells, and emergencies such as lockdown, even when the district connection is unavailable.
9. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.
10. All cabling shall comply with Division 27 cabling specifications.
11. Systems that do not comply with the feature-sets highlighted in this Specification will not be considered.

### 1.3 DEFINITION OF TERMS

- A. Installer(s): Shall refer to the person, persons, or company who or which actually contracts to perform the work specified herein.

### 1.4 SUBMITTALS

- A. Product data for each component showing electrical characteristics and connection requirements.
- B. Shop Drawings: Prior to proceeding with the work: Provide detailed equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, location of each field connection, and a complete schedule of all equipment and materials with associated manufacturer's cuts sheets which are to be used.
  - a. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout system and impedances.
  - b. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.
  - c. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, Systems Contractor's name in the title block.
  - d. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.
- C. FCC Approval: The system shall be approved for direct interconnection to the telephone utility under Part 68 of FCC rules and regulations. Systems, which are not FCC approved or utilize an intermediary device for connection, will not be considered. Provide the FCC registration number of the system being proposed as part of the submittal process.

- D. Product Certificates: Signed by manufacturers certifying that products furnished comply with specified requirements.
- E. Installer Certificates: Signed by manufacturers certifying that Installers comply with specified requirements.
- F. Manufacturer Certificates: Signed by manufacturers certifying that they comply with specified requirements.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- H. Operation and Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.
  - a. Record of Owners equipment-programming option decisions.
  - b. All instructions necessary for proper operation and manufacturer's instructions.
  - c. "Proof of Performance" information.
  - d. Manufacturer's maintenance information.
  - e. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.
- I. Record As Built Drawings: Prior to final acceptance, provide three (3) complete sets of As Built drawings (Arch E – 32x40) with a floorplan diagram of the system installation details indicating actual wiring layout and locations of field devices and all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".
  - 1. Provide AutoCAD drawing files of the As Built Drawings on an 8MB thumb drive. AutoCAD 2017 or later.
- J. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.
  - a. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
  - b. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
  - c. Include with the submittal a current copy of trainer's needs assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
  - d. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.
  - e. Provide a minimum of eight hours of instruction in proper operation and routine maintenance of the system. Instruction shall cover all materials indicated in the Owner's operations manual.
  - f. Operational guidelines shall be given in written form in sufficient numbers so that all key personnel have operational instructions of programming, station use and special features. Copies of these instructions shall be provided for permanent record in the operations and maintenance manuals.
- K. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required **five-year** warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. Provide the following within thirty (30) days after notification to proceed:
1. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Random installations from other vendors and/or Installers shall not be accepted. The Installer, not its employees, must meet these qualifications .
  2. The Installer shall be bondable.
  3. The Installer shall demonstrate to the satisfaction of the Owner or his representative that he has:
    - a. Adequate plant and equipment to pursue the work properly and expeditiously.
    - b. Adequate staff and technical experience to implement the work.
    - c. Suitable financial status to meet the obligations of the work.
    - d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
- B. Any Contractor, who intends to bid on this work and does not meet the requirements of the "Quality Assurance" paragraph(s), shall employ the services of an "Installer" who does meet the requirements and who shall provide the equipment, make all connections and continuously supervise the installation. A subcontractor so employed as the "Installer" must be acceptable to the Architect/Engineer. The "Installer" shall be identified within thirty (30) days of notification to proceed for acceptance by the Architect/Engineer.
- C. Because the life expectancy of this type of communications structure normally exceeds 10 years, the owner expects continuity from the service provider. If the installing/servicing company has not been an authorized provider of the manufacturer's product for it least (10) years, the following is required:
1. A list of (2) systems manufacturers of which they currently are authorized service providers where the relationship exceeds (10) years.
  2. A letter from the manufacturer outlining the details of changes in service providers over the last (10) years and what actions they will take to ensure continuity of service to the customer.
- D. Each major component of equipment shall have the manufacturers name, address and model number on a plate securely affixed in a conspicuous place. NEMA code ratings, UL Label, or other data that is die-stamped into the surface of the equipment shall be easily visible.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- F. Comply with NFPA 70
- G. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools.
- H. Comply with UL 60950.

## 1.6 IN-SERVICE TRAINING

- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.

- B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.
- C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.

## 1.7 PRE-INSTALLATION MEETINGS (Required)

## 1.8 WARRANTY

- A. Provide a **manufacturer's five-year warranty** of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic system components. Additional warranties cover clocks, speakers, and call in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one year warranty shall be provided for labor.
- B. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary. The standard five-year warranty is an important element in establishing a standard in quality. Manufacturers who circumvent the five-year warranty by offering special "extended warranties" that are not part of their normal published warranty will not be accepted.
- C. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge.
- D. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

## 1.9 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following system:
  - 1. Telecenter U IP manufactured by Rauland. No substitutions.
    - a. Authorized Rauland Distributor contact:  
Name: Firetron Inc  
Address 10101a Stafford Center Drive  
Contact: Richard Phillips  
Email: [rphillips@firetron.com](mailto:rphillips@firetron.com)

## PART 2 - PRODUCTS

### 2.1 SYSTEM REQUIREMENTS



- A. The platform shall utilize state of the art IP Technology for Call-in Notification, School Safety Paging and Evacuation tones, Atomic Time Synchronization, Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Communications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web-based and user friendly to allow the system administrator the ability to easily program system features.
- B. Provide complete and satisfactorily operating district/school communications and district/school safety as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.
- C. The platform shall be a single electronic system consisting of a minimum of 10 audio channels for each campus, (classroom) IP Speaker Modules and call switches, IP Zone Modules connecting corridor speakers, inside and outside horns, IP Administrative Consoles, SIP enabled PBX integration and district-wide integration for paging, emergency notifications, calendar scheduling and configuration.
- D. Cafeteria and gym intercom speakers should cover entire area; a minimum of six (6) speakers in each gym and nine (9) in each cafeteria. Additional speakers shall be added if required for better coverage.
- E. Each Classroom shall be provided with a Speaker Module interface and a minimum of 5 different call switches, each with their own annunciation path and priority.
- F. Call-ins may automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones, and outside phones.
- G. Call-ins shall be programmed to automatically change priority and annunciation route based on age of call-in and original priority.
- H. Call-ins may have priority (and annunciation route) changed by user action from a console or SIP enabled phone.
- I. Call-in annunciation route shall include playing pre-recorded audio over speakers, sending a pre-configured email, and activating relays.
- J. The platform shall lend itself to expansion by simple addition of hardware modules.
- K. The platform shall connect directly to an existing, standard protocol WAN/LAN network, without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can be remotely created, changed, stored and downloaded to the system by an authorized user from a web-based user interface.
- L. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone or connected web browser within the facility or outside the facility to any other location within the facility or district.
- M. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands-free and will not require any interaction by the classroom user.

- N. The platform shall provide classroom users the ability to confirm that they have safely secured their classrooms during an emergency with a single button press. The front office administrator will receive confirmation that the classroom is safely secured via an administrative console and web-based user interface. The front office administrator can view classrooms that are not safely secured via the administrative console. The front office administrator can view classrooms that are not safely secured via the web-based user interface. The front office administrator shall be able to initiate two-way communication, without a pre-announcement tone, to the classroom during an emergency via the administrative console. Web-based user interface will still identify that a school is in an emergency, even if all classrooms are safely secured. Individual classroom check-in and school emergency status shall be viewed from the web-based user interface, both on-site and remotely.
- O. IP Addressable and POE powered Speaker Modules for individual rooms shall be system programmable and may be assigned any two, three, four, five or six digit number as well as name and description. Any extension may be reassigned at any time.
- P. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in a campus. This shall allow hands-free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when speaker monitoring is active, complying fully with all privacy legislation. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.
- Q. The platform shall allow users to configure multiple schedules per school, with a minimum of 500 unique events per schedule, and automatic Daylight Savings time correction. Schedules can be programmed to occur once, daily, weekly, monthly, or in any combination of the preceding recurrences. Each school may have a minimum of 20 unique bell schedules, with a minimum of 5 active schedules on any given day for each campus. User shall be able to select from 25 standard included tones as well additional user created and uploaded audio files for class change signaling and messaging. In addition, scheduled events shall include relay actions, email notifications, and paging exclusions as system configuration changes. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate server at each school location. Bell schedules can be remotely created, changed, stored and assigned to calendar days for the local school by an authorized user from a web-based user interface.
- R. The platform shall be able to integrate with an existing PA system or operate as a fully independent IP solution. The platform shall be able to function in combination of said configurations, and allow for seamless communication within a school or district-wide, regardless of the type of configuration used. The platform shall be scalable, with the ability to easily add, install, and configure additional equipment to a system.
- S. The platform allows for customization of preprogrammed sequences, used for emergencies, events, and everyday communications. Preprogrammed sequences can be activated from the push of a relay button, soft key of an administrative console, a dial string of a SIP phone, or a web browser configured to the district network. Sequences can be initiated automatically as part of a schedule or on the fly. Preprogrammed sequences can be customized to utilize any combination of audio tones, emails, relays, tone exclusions, swings, delays, duples, SIP phone notifications, and program distribution. Audio tones can include customized audio files and voice messages, recorded in any language. Uploaded audio tones and messages can be preprogrammed to announce repeatedly or individually, as part of a scheduled sequence or on the fly. Each school in a district can have its own customized sequences, and can be activated individually, in groups, or district-wide.
- T. Exterior speakers shall be zoned in groups, with a separate signal feed routed to each individual zone. Audio signal routed to each zone shall be controlled by the Owner (MUTE / UN-MUTE).

Reference drawings for speaker zones groups. Provide the Owner a simple interface to successfully and easily operate this function.

## 2.2 EQUIPMENT AND MATERIAL

### A. Program Source

1. Use single gang input jack at reception desk. RDL D-J3 Wall mount RCA and XLR Mic/Line Input or equal. Location of this jack may be different for each school, depending on counters and cabinets. Jack shall be mounted near an outlet for power requirements. This replaces CD player, radio, mixer, and desktop rack unit. Jack is to be wired and run to head end rack where it connects to Telecenter U Line Input Module. Use copper/analog wiring, not Cat 6 network wiring.

### B. Server Software

1. Provides district-wide paging, bell event scheduling, emergency notification and configuration for entire district.
2. Ability to configure system and initiate system features, per school and district-wide via web-based user interface.
3. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or district's network time server.
4. The software will provide a web browser to deliver district-wide emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN/LAN of an alarm condition.
5. The software can automatically broadcast emergency instructions via associated system hardware throughout an entire district when an alarm (e.g. lockdown, lockout, security, fire) is initiated via the web-based user interface. The emergency instructions are preprogrammed and require no user intervention. Bell tones are able to be halted during an emergency. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
6. The software allows for user-uploaded pre-recorded messages and tones. Software supports the upload of MP3 and WAV file types. User-uploaded pre-recorded messages and tones can be part of emergencies, sequences, and bell schedules.
7. The software can be installed in cloud, virtual or physical server environments.
8. The web-based user interface supports secure HTTP browsing.
9. The software supports encryption to ensure secure access.
10. The system shall monitor itself if devices go offline and system actions are not received. Specified users shall receive email notifications when devices go offline. The software shall be able to keep a log and report on system activity within a school or all schools district-wide for a minimum of one year. These reports can be exported to excel spreadsheets.
11. The software will support a minimum of 20 bell schedules per school, with 5 schedules assignable to a specific school day. Bell schedules can be programmed to announce tones, activate relays, send emails, activate program distribution, and notify SIP phones.
12. The system allows programmable end points to be automatically included or excluded for live paging, bell tones, or prerecorded audio, depending on the time or day or day of the week. These inclusions/exclusions can be applied manually or automatically depending on their schedule.
13. The software can automatically send an email, as part of a programmed sequence of events, to district administrators alerting them of an emergency within the district.
14. The software provides the ability to view schools that are in an emergency status, using any web browser on the district's network. The software shall identify the name of the school in an emergency as well the type of emergency that school is in.

15. The software provides the ability to view individual classrooms that are not checked-in during an emergency, using any web browser on the district's network. The software shall identify the name, extension, and description of the classroom that is not checked-in during the emergency.
16. The system has a minimum of 5 customizable emergencies, one of them being an All-Clear – with the ability to return the system from an emergency to normal status. Each emergency shall have a minimum of 500 unique events.
17. As a district-wide communications solution, the system shall be able to provide simultaneous communications to all schools or groups of schools within a district. The system shall allow a user to initiate district-wide communications to individual schools, all schools or groups of schools, from a web-based user interface. The system shall allow a user to initiate prerecorded audio, live paging, or programmed sequences to individual schools, all schools or groups of schools, from the web-based user interface. Programmed sequences shall be customizable per school, and the system shall be able to activate them simultaneously to individual schools, all schools or groups of schools, from the web-based user interface.
18. The communications software must allow upgrade from an individual school system to multiple schools, or an entire school district, using the same web-based user interface. The communications software from an individual school system must be identical in typical user operation to the multiple schools or entire school district communications system software.

C. Campus Controller

1. Shall integrate with existing District-wide Cisco IP telephones. Coordinate with Intercom Consultant and CFISD.
2. Provides call routing for paging and intercom for a single facility.
3. System shall connect to the district provided Telephone Network via a SIP connection.
4. Support a flexible numbering plan allowing two, three, four, five, or six digit extensions.
5. SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages and change priorities of call-ins in progress.
6. Direct dialing, two-way amplified voice intercom between any provided telephone or admin console and speaker without the use of a press-to-talk or talk-listen switch.
7. Ability to upgrade priority level from individual call switch.
8. The ability to answer intercom call-ins registered at administrative consoles and pre-selected telephones.
9. The ability to automatically escalate incoming call-ins to an alternate telephone or group of telephones if they remain unanswered for a predetermined amount of time.
10. The ability to manually upgrade an intercom call-in to an alternate telephone or group of telephones.
11. The ability for classrooms to “check-in” via push button when they have successfully secured their location during emergency.
12. Administrative console shall display locations that have not checked in to confirm their secured location and provide hands-free audio monitoring and communication to unsecured locations.
13. The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP network.
14. Single button access from any console on the system to distribute emergency announcements within the facility to all or select locations equipped with speakers. Emergency announcements originating from any assigned administrative console shall have priority over all regular system functions.
15. Ability for administrative consoles and connected phones to selectively monitor audio at any two way speaker during an emergency.

16. Stores a minimum of 48 hours' worth of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.
17. System has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server.
18. System's SIP Interface shall provide:
  - a. Audio paging access from any telephone to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire facility.
  - b. Ability to answer a call-in directed to that SIP extension.
  - c. Ability to upgrade a call-in directed to that SIP extension.
  - d. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
  - e. Ability to initiate a school-wide emergency including lockdown and evacuate sequences.
  - f. SIP device shall display call-in information from call in switch. Information will include a minimum of Classroom Name, Number, and Priority Level.
19. The system will have the ability to utilize a web browser and a USB microphone connected to the PC to deliver district-wide live emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.
20. The system can automatically broadcast emergency instructions throughout an entire campus when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. Bell tones are able to be halted during an emergency. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.

D. IP Addressable Modules:

1. System shall provide multiple IP Addressable Modules for intercom, paging and relay activation.
  - a. All Modules are POE 802.3af compliant
  - b. All Modules support DHCP.
  - c. All Modules connect to network with a single RJ45 connector
2. IP Addressable Speaker Module
  - a. Shall interface to school's data network, a classroom speaker, and multiple call switches.
  - b. A minimum of 5 levels of call-in can be placed from an IP Speaker Module. The call-ins are routed to administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones, consoles, and speakers.
  - c. An option for Privacy call in switches is supported. When the Privacy switch is activated it prevents administrative or classroom telephones from monitoring the specific classroom/location intercom speaker.
  - d. The ability to belong to one or more of a minimum of 100 independent zones for zone paging, program/music distribution zones and class change tone zones; this assignment is a programmable function, changeable by time of day. Each IP Speaker Module's location shall be programmed in software to belong to any combination of software zones. IP Speaker Modules shall be designed to mount near ceiling and wall speakers and in the plenum space.
  - e. Intercom and paging volume adjustable from Software interface.
3. IP Addressable Zone Paging Module

- a. Zone Paging Module shall connect multiple speakers for district all page, all page, zone paging, bells, audio events and, emergency notification.
  - b. Zone Paging Modules shall be rack and wall mountable.
  - c. Zone Paging Modules shall be able to belong to one or more of 100 independent zones for live paging, bells, pre-recorded audio and emergency notification.
  4. IP Addressable Aux I/O Module
    - a. Aux I/O Module shall have two input contacts and two output contacts.
    - b. Input and output contacts are individually addressable.
    - c. Aux I/O Module shall be wall and rack mountable.
    - d. User can program relays to be activated manually, through an event/bell schedule, or during emergency notification.
    - e. Aux I/O Module can perform school lockdown from a single press of a panic button.
  5. IP Addressable Program Line Input Module
    - a. Program Line Input Module shall provide line level audio program distribution into system.
    - b. Program Line Input Module shall have a 3.5mm cable jack.
    - c. Program Line Input Module shall be configured via web-based user interface.
    - d. User can configure program distribution to be activated manually or automatically through an event/bell schedule.
    - e. Program Line Input Module will have a system priority level such that emergency communications override program distribution.
- E. IP Addressable Analog Gateway
1. IP Addressable Gateway provides integration with existing analog wiring infrastructure – consisting of shielded two-pair classroom field wiring. The Gateway provides the ability to reuse speaker wiring, speakers, and punch blocks to integrate analog infrastructure with IP platform.
  2. Each Gateway will have 5 watts of power per port and 25 watts total per device.
  3. Supports 24 classrooms that utilize 25 Volt speakers and all current Telecenter call switches for front office notification.
  4. Supports minimum of 5 call switch priorities per classroom, capable of lockdown check-in functionality, while reusing existing shielded two-pair classroom field wiring.
  5. Classroom intercom volume adjustable from Software interface.
  6. Classroom paging volume adjustable from Software interface.
  7. Configured to the school network and can be used in conjunction with IP Addressable Modules.
- F. IP Addressable Administrative Console
1. A full color screen with 64 soft keys, 3 line select, volume control, push to talk, speakerphone mode and left/right and up/down scrolling.
  2. Audio paging access from any Console to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire school.
  3. Programmable soft key access from any console on the system to initiate alarm signals within the school to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative console shall have priority over all regular system functions.
  4. Programmable soft key access from any console to automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
  5. Ability to perform intercom to any single IP Addressable Speaker Module.

6. Ability to display 3 call-ins at a time on the screen while other call-ins are annunciating and the ability to scroll to view all call-ins.
  7. Ability to upgrade a call-in via soft key.
  8. Programmable soft key access from any console for activating relays, campus wide.
  9. Ability to maintain, along with controller and other IP Modules system functions, including intercom, bells and paging for the local campus in the event of district-wide connection loss.
  10. Classrooms that have not 'checked-in' during an emergency are listed on the Administrative Console's screen.
  11. The time duration of an emergency is shown on the screen of the administrative console. The check-in timer is shown on the screen of the administrative console.
- G. Audio Paging/Program Amplifiers
1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging speakers, and 15 watts of power to all paging horns.
  2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.
- H. Normal/Emergency Call Switch – Rauland Dual Level Call In Switch
1. Normal/Emergency Call Switches indicated on the drawings shall provide the following functions and features:
    - a. One (1) "Normal" call switch that shall activate a distinctive "NORMAL" level call from single button activation. The button shall be clearly marked "NORMAL" and will route the call-in to any one or more Administrative Consoles and/or Marquee Displays for quick and easy response from an Administrative Console.
    - b. One (1) "Emergency" call switch that shall activate a distinctive "EMERGENCY" level call from single button activation. The button shall be red in color and shall be clearly marked "EMERGENCY" and will route the call-in to any one or more Administrative Consoles and/or Displays for quick and easy response from an Administrative Consoles.
  2. Call button to be Rauland Model #603302.
- I. Emergency/Check-In Call Switch – Rauland Check-In Call In Switch
1. Emergency/Check-In Call Switched indicated on the drawings shall provide the following functions and features:
    - a. One (1) "Emergency" call switch that shall activate a distinctive "EMERGENCY" level call from single button activation. The button shall be red in color and shall be clearly marked "EMERGENCY" and will route the call-in to any one or more Administrative Consoles and/or Displays for quick and easy response from an Administrative Consoles.
    - b. One (1) "CHECK-IN" call switch that shall activate a distinctive "CHECK-IN" level call from single button activation. The button shall be blue in color and shall be clearly marked "CHECK-IN" and will route the call-in to any one or more Administrative Consoles. This button will be used for emergency check-ins during school emergencies, notifying the front office of the classroom occupants' safety during an emergency.
- J. Equipment Racks
1. All equipment racks shall provide 35 spaces (61") minimum for mounted system equipment.
  2. All equipment racks shall be multi-rack format ("gangable") style, bolted together, and open cavity.
  3. All equipment racks will be provided with lockable rear doors.
  4. Equipment rack(s) shall be located in climate-controlled areas/rooms as shown on drawings.

5. All head-end, distribution, and source equipment, including data and power, shall be located in racks configured as approved by the Engineer.
  6. Rack mounted equipment shall be accessible from front and rear.
  7. All unused rack spaces will be covered with appropriate blank/vent panels.
- K. Terminal Cabinets
1. A terminal cabinet with a sufficient number of bushed openings shall be installed in the wall behind the intercom control console equipment rack. Cabling between the equipment rack and the main junction box shall be provided with telephone type 50 pin connectors to allow ease in console connections, disconnections and service. Satellite terminal junction boxes shall be provided as needed to allow for station terminations in each building.
- L. Backboards
1. Provide 4 foot x 8 foot plywood backboards for mounting of system cross connect field. Mount as shown on the plans. Provide Modular Termination backboards with 66 type terminal blocks as required to terminate all cables. Provide distribution and cross connect backboards equal to 66 type Series for all cross-connect wiring.
- M. Jacks
1. All station device terminations (except speakers) shall be terminated on USOC standard modular jacks. Jacks for wall mounted telephones shall have lugs for securely attaching the instrument to the wall.
- N. Classrooms Speakers for IP System:
1. Rauland TCC2011A IP Module with BAFKIT2X2L8RJ Speaker or equal, to be used in classrooms.
- O. Office and Hallway Speakers:
1. Quam 17URS 2X2 Lay-In Speaker or equal. These offices shall have a volume control.
- P. Bathroom and Hard Ceiling Speakers:
1. Rauland ACC 1400 or equal with backcans.
- Q. Wall-mount Surface Speakers – provide flush mount type.
- R. Cafeteria and gym intercom speakers should cover entire area; a minimum of six (6) speakers in each gym and nine (9) in each cafeteria. Additional speakers shall be added if required for better coverage.
- S. Horns, Flush Mount
1. Provide double re-entrant type horn loudspeakers with integral driver. The horn loudspeaker shall be impervious to weather and vandalism. Horn shall be constructed of heavy-duty ABS plastic. Horn loudspeaker drivers shall be rated at 15 watts with a frequency response of 480 Hz to 14 KHz. Sensitivity shall be 106 dB 1 watt, 1 meter. Transformer assembly shall be dual voltage multi-tap type suitable for 25 or 70-volt installations. Dispersion pattern shall be 180 degrees conical. The horn loudspeaker shall be constructed of treated heavy gauge aluminum, with all exposed parts potted and a sealed driver. Wiring terminal shall be fully enclosed. The speaker flange and mounting surface shall have a cork-rubber gasket. The horn loudspeakers finish shall be gray baked on enamel.
  2. The recessed back box shall be of heavy gauge cold-rolled steel, spot welded for stability with a rust-retardant gray primer finish. Acoustically treat the interior to eliminate mechanical resonance. The back box shall be 10-3/4"x10-3/4"x6" deep.



3. The baffle shall be vandal proof, the faceplate constructed of 14-gauge carbon steel with a minimum tensile strength of 55,000 PSI. A lattice grid sub-plate shall deny access to the horn but be acoustically transparent for sound projection. Provide tamper proof, stainless steel mounting hardware. The baffle shall have a mar/scratch baked epoxy rust inhibitive finish.
  4. Flush mount with vandal-resistant metal baffle similar to Atlas/Soundolier Model VP161-APF. Baffle shall be square and designed for flush mounting. Provide backbox designed for flush mounting. Backbox shall be metal with all-welded seams and undercoated to eliminate mechanical resonances. Box shall have rust-resistant coating. Backbox shall be Atlas/Soundolier Model 193 Series deep box for specified speaker and baffle, or approved equal. Install gaskets to seal enclosure to speaker. Backboxes and conduit shall be sealed and secured to the building.
  5. For all 25/70V applications, ie. corridors / exterior horns, provide and install 24-port hybrid gateways and ZPM modules.
- T. Uninterruptible Power Supplies (UPS)
1. UPS equipment provided for this system will include Power Conditioning to smooth current and voltage fluctuations and shall comply with Division 27 specifications.
  2. UPS equipment will be sized in accordance with the system manufacturer's recommendations.
  3. Provide an individual UPS for EACH SYSTEM Gateway furnished with the system.
  4. Provide additional UPS(s) for protection of all other equipment furnished with the system and housed in the equipment racks.
  5. All UPS equipment shall be rack mounted.
  6. Provide over voltage and transient spike surge protector to condition AC voltages into all microprocess control systems. Tripp Lite IsoBar.
- U. Clock System
1. For new construction, provide Master Clock by Sapling, with daylight savings time pre-programmed via connection to intercom controller. Clocks are to be installed in the following locations only:
    - a. Cafeteria / Commons – 16" clock
    - b. Library – 16" clock
    - c. Clinic – 12" clock
    - d. Gymnasiums – Middle Schools and High Schools: 16-inch clock, with protective wire cage; Elementary Schools: LED message board with protective wire cage.
    - e. Behind receptionist area – 12" clock
  2. At all renovations, provide Master Clock, Power Supply and Clocks by Sapling. Clocks are to be installed at the following locations:
    - a. Cafeteria / Commons – 16" clock
    - b. Library – 16" clock
    - c. Clinic – 12" clock
    - d. Gymnasiums – Middle Schools and High Schools: 16" clock, with protective wire cage; Elementary Schools: LED message board with protective wire cage.
    - e. Behind receptionist area – 12" clock
    - f. All other clocks on this system shall be removed and the wall patched and painted to match existing surface.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the School Communications and School Safety Network.
- B. Do not proceed until unsatisfactory conditions have been corrected.

### **3.2 SURGE PROTECTION**

- A. Provide over voltage and transient spike surge protector to condition AC voltages into all micro-processed control system. Tripp Lite IsoBar.

### **3.3 EXTERIOR MOUNTING**

- A. Flush mount with vandal-resistant metal baffle similar to Atlas/Soundolier Model VP161-APF. Baffle shall be square and designed for flush mounting. Provide backbox designed for flush mounting. Backbox shall be metal with all-welded seams and undercoated to eliminate mechanical resonances. Box shall have rust-resistant coating. Backbox shall be Atlas/Soundolier Model 193 Series deep box for specified speaker and baffle, or approved equal. Install gaskets to seal enclosure to speaker. Backboxes and conduit shall be sealed secured to the building.

### **3.4 WIRING**

- A. Wire shall be #22 gauge at a minimum. Wire for communications systems shall consist of (1) twisted pairs #22 copper under jacket and one (1) twisted pair #22 under shield solid copper with overall plenum rated PVC jacket .No splices are permitted except in approved junction boxes. All terminations shall be made on telephone type punch blocks or at specified devices. Display, speaker, and specialty cables shall be as required for best operation under manufacturer recommendations. All IP speaker/modules shall be wired by structured cabling contractor. All local low voltage by intercom contractor.

### **3.5 INSTALLATION**

- A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
- B. Furnish and install all material, devices, components and equipment for a complete operational system.
- C. Impedance and Level Matching: Carefully match input and output impedance's and signal levels at signal interfaces. Provide matching networks where required.
- D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
- E. All housings are to be located as indicated.
- F. The contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.

- G. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- H. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.
- I. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
- J. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

### **3.6 GROUNDING**

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

### **3.7 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. Inspection: Make observations to verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

### **3.8 FINAL ACCEPTANCE TESTING**

- A. The Final Acceptance Testing shall be provided to the Owner or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.

- B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

### **3.9 COMMISSIONING**

- A. The contractor shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6 of these specifications. In addition to the Training Materials provided, the contractor will also furnish Operators Manuals and Users Guides at the time of this training.
- B. Schedule training with Owner through the owners representative, with at least seven days advance notice.

### **3.10 OCCUPANCY ADJUSTMENTS**

- A. The contractor shall provide Occupancy Adjustments in accordance with Section 1.6 of these specifications. A response scenario amenable to both the owner and the contractor will be established and followed for the first year of service.

### **3.11 CLEANING AND PROTECTION**

- A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked and all cabinet keys will be turned over to the owner or designated owner's representative.

END OF SECTION

## **SECTION 27 51 23.80 – LOCAL SOUND REINFORCING SYSTEMS**

### **PART 1 - GENERAL**

#### **RELATED WORK**

- A. Section 27 00 00 – BASIC MATERIALS AND METHODS

#### **1.1 GENERAL REQUIREMENTS**

- A. Provide all materials, equipment, transportation and labor to achieve complete and fully functional systems as shown or intended on drawings and in bid specifications.
- B. Maintain a fully functioning system in unaffected areas.
- C. Remove all abandoned equipment and return to Owner; remove all abandoned wiring, patch surfaces at wall and floor penetrations.
- D. Maintain access to all existing equipment.
- E. If above ceiling work is being performed in a classroom or a space where there is an installed local sound reinforcement system, prior to construction, a system test will be required of the contractor to demonstrate the current state of the system. Any non-functioning item at this time shall be noted and addressed by CFISD maintenance. If system is proven to be 100% functional, the contractor is responsible to any repair necessary to return it to its previous state.
- F. If applicable, at Substantial Completion or when system is ready to be tested, a demonstration is required by the contractor to demonstrate the system mirrors the system condition prior to construction. If system is not functioning the same prior to construction, the contractor shall make necessary repairs to bring the system back up to the pre-construction condition.
- G. All applicable equipment shall bear the UL label. All work shall be executed in accordance with the National Electric Code (NEC), the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances and regulations.
- H. Contractor shall have been in the commercial AVL (Audio, Video, Lighting) installation industry for at least five years. Contractor shall have installed at least five systems of this type and comparable scale in educational facilities within the State of Texas. Contractor shall provide a list of successfully completed projects including completion dates within the past two years from the bid date of this project.
- I. Should the local sound systems include Crestron or AMX hardware which requires programming, the Contractor shall provide a Certified Crestron Programmer or an AMX Certified Expert (ACE) Programmer to program, upload and debug the third party control systems.
- J. Any discrepancy in quantity or part numbers between the drawings and the bid specifications shall be brought to the attention of the Consultant for clarification during the bidding period. No allowance shall be made to the Contractor by reason of failure to have brought said discrepancies to the attention of the Consultant prior to award of contract. Should discrepancies be discovered, the greater in quality and quantity shown shall be provided.

## 1.2 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
  - 1. Latest Local Codes and Amendments
  - 2. 2015 National Electrical Code
  
- B. Other References:
  - 1. TIA/EIA-568-A – Commercial Building Telecommunications Wiring Standard
  - 2. EIA/TIA-569 – Commercial Building Standard for Telecommunication Pathways and Spaces.
  - 3. TIA/EIA-606 – The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
  - 4. TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
  - 5. EIA/TIA 455-A – Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
  - 6. TIA/EIA TSB 67 – Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
  - 7. TIA/EIA TSB 72 – Centralized Optical Fiber Cabling Guidelines
  - 8. ISO/IEC 1180 – Generic Cabling Standard
  - 9. EN 50173 – Generic Cabling Standards for Customer Premises
  - 10. ANSI/EIA/TIA 526-14 – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.
  
- C. Governing Codes and Conflicts:
  - 1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

## 1.3 ABBREVIATIONS

- A. The following abbreviations are used in this document:

## 1.4 SUBMITTAL DOCUMENTATION (Required)

- A. Product Data: Submit data showing electrical characteristics and connection requirements.
  
- B. Shop drawings: Provide wiring diagrams clearly indicating proposed equipment and interconnection of all internal and external components. Include dimensional details of all mounting including rack elevations and ergonomic layouts.
  
- C. Operation and Maintenance Data: Submit instructions for operating system and performing routine troubleshooting procedures.
  
- D. As-builts: provide AUTOCAD floor plan diagram of the system installation details indicating actual wiring lay-out and actual locations of field devices such as call buttons/handsets and speakers.

### **1.5 PRE-INSTALLATION MEETINGS (Required)**

- A. Training
  - a. A minimum of eight hours for instruction in proper operation and routine maintenance of the system. Instruction shall cover all materials indicated in the Owner's operations manual.
  - b. Operational guidelines shall be given in written form in sufficient numbers so that all key personnel have operational instructions of programming, station use and special features. Copies of these instructions shall be provided for permanent record in the operations and maintenance manuals.

### **1.6 WARRANTY AND SERVICE**

- A. The Contractor shall warrant all new equipment to be free of defects in materials and workmanship for not less than one year after the Substantial Completion date.
- B. The systems are to be free of defects and deficiencies and are to conform to the drawings and specifications as to kind, quality, function and characteristics. The Contractor shall repair or replace defects which may occur in labor or materials within the warranty period without charge to the Owner.
- C. Within the warranty period, respond to requests for service within 24 hours. Service calls to perform warranty work shall be made within 72 hours of request by the Owner. Temporary, equivalent replacement equipment shall be provided at no cost to the Owner when immediate on-site repairs cannot be made.
- D. This warranty shall not void or replace individual manufacturer warranties which extend past this warranty period. This warranty shall not void any rights guaranteed the Owner by law.
- E. The Contractor shall include in the close-out documentation a certificate of warranty which includes the start and end dates of the warranty and contact information, including name, telephone number and email, of individuals to perform warranty service.
- F. This warranty shall not apply to existing Owner Furnished Equipment.
- G. Additional warranties may be negotiated between the Contractor and the Owner at the Owner's discretion.

### **1.7 SUMMARY OF WORK**

- A. ADDITIONS/RENOVATIONS (Existing buildings w/ analog recording).
  - 1. Maintain a fully function system in unaffected areas.
  - 2. Removed all abandoned equipment and return to Owner; remove all abandoned wiring and patch surfaces at wall and floor penetrations.
  - 3. Maintain access to all existing equipment.
  - 4. Iff above ceiling work is being performed in a classroom or a space where there is an installed local sound reinforcement system, prior to construction, a system test will be required of the contractor to demonstrate the current state of the system. If system is proven to be 100% functional, the contractor is responsible to any repair necessary to return it to its previous state.
  - 5. If applicable, at Substantial Completion or when system is ready to be tested, a demonstration is required by the contractor to demonstrate the system mirrors the system condition prior to construction. If system is not functioning the same prior to

construction, the contractor shall make necessary repairs to bring the system back up to the pre-construction condition.

- B. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
  - 1. Reference project drawings for locations, quantities, and coordination with other trades.
- C. All local sound racks shall have cabling installed and routed according to industry standard best practices. Contractor shall employ horizontal lacing rails in the rear of the rack for neat and orderly cable routing. Use Velcro strips for cable bundling. ZIP TIES ARE NOT ACCEPTABLE.
- D. Contractor shall perform an RF scan and shall provide results in pdf format with the close-out documentation. Contractor shall provide an RF coordination sheet, documenting all RF frequencies in use in each system, including in the High School buildings, to ensure there is no RF interference between systems. Coordinate with General Contractor and for access to High School building systems.
- E. Contractor shall tune each system's DSP to provide a flat frequency response.
  - 1. Tune and set dynamics on all inputs to provide the highest level of gain before feedback while providing intelligibility of all inputs.
  - 2. Contractor shall perform a "rattle test" of all systems: Apply sine wave sweep signal to each loudspeaker system with a two minute sweep from 20Hz to 550Hz, to 10 - 15dB below full system output. Annotate issues discovered during sweep test. Correct issues resulting from the new system equipment and / or rigging hardware.
- F. Contractor shall provide all required equipment and programming to provide a fire alarm override. All audio shall mute in all local sound systems during a fire alarm.

## **PART 2 – MATERIALS**

- A. All equipment shall be new and unused unless otherwise noted.
- B. Contractor shall provide all necessary patch cables, riser/plenum cabling and connectors interconnecting all equipment to provide for fully functional systems. In addition, all cabling raceway, support systems, sleeves and any other materials required to properly install and support cabling systems.
- C. All equipment quantities shall be as shown on drawings unless otherwise noted.
- D. All materials are to be provided as specified. No substitutions shall be accepted without written request from the Contractor and written consent of the Consultant.

### **2.1 CAFETERIA / GYM**

- 1. Amplifier: DSP (with controls) & Amplifier by Crown, QSC, or Ashly. Three mic jacks, (1) in riser and (1) on either side of stage ATLAS S501-13C.
- 2. Rack: DWR Pivoting Wall Rack SKU: DWR-18-22PD. To house ALL local sound equipment.
- 3. Bluetooth receiver.
- 4. Three (3) Microphones Shure PGA 58-LC
- 5. Three (3) Atlas MS-18C stand



6. Three (3) Generic 25'-0" microphone chords
7. One (1) Atlas DS-5 Desk Stand
8. Digital Wireless Mic System – Shure QLX/ULX Wireless
  - i. Two (2) receivers
  - ii. Two (2) Handheld Transmitters
  - iii. Two (2) Belt Pack Transmitters
  - iv. Two (2) WH 30 Head worn Mics
  - v. Two (2) WL 185 Lapel Mics
  - vi. Active Directional Antenna
9. Wall Cabinet to house all local sound equipment.
10. ASSISTED LISTENING SYSTEM (ALS)
  - a. Williams Sound PPA L157 system with PPAR35 receivers, one RPK005 rack mount kit and one ANT005 whip antenna.

## **2.2 FIRE ALARM OVERRIDE**

- A. Provide for Fire Alarm Override for each Local Sound system. Contractor shall provide all cabling, relays, mounting hardware and any other devices (Fire Alarm System devices by others) to provide a fully functioning Fire Alarm Override system. When Fire Alarm is active, each Local Sound System shall be muted. When Fire Alarm ceases, each Local Sound System shall automatically revert to normal operation.

## **2.3 SCHOOL INTERCOM PUBLIC ADDRESS OVERRIDE**

- A. Provide for School Intercom Public Address Override for each Local Sound System. Contractor shall provide and install (1) RDL TX-70A, 70v to Line level converter. Contractor shall provide, install and terminate cabling to nearest School Intercom speaker and shall integrate devices into local sound system. Provide DSP programming to duck Local Sound System to give priority to the School Intercom PA System. Coordinate with Building Intercom Contractor for integration of systems

## **2.4 CABLE ROUTING/PATHWAY**

- A. Cable Support System: All audio-video cabling shall be installed and supported using a cable support system at 4'-0" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

## **2.5 AUDIO-VIDEO SYSTEM WIRING AND TERMINATING HARDWARE**

- A. Cabling:
  1. Provide a complete audio/video cabling solution from back of each faceplate to device I/O locations as designated on the contract drawings. Each cable provided shall be installed with a minimum of 10' of excess slack above each

outlet location. Contractor shall properly support and label all cabling at each outlet.

2. Contractor shall ensure all cabling requirements are met to provide fully functional A/V systems, specified cabling notwithstanding.

### **PART 3 – EXECUTION**

#### **3.1 WIRING AND INSTALLATION TECHNIQUES**

- A. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.
- B. Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on standard duplex outlets. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground per NEC with third wire (green) to panel ground lug at breaker supply panel.
- C. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least five.
- D. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.
- E. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.
- F. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.
- G. All wiring shall be labeled using vinyl wire labeling tags. Use Brady™ model BMP21 or equal wire labeling printer. Label input, output and wireless wiring. Label electrical power breaker at electrical panel. Label location of room and power panel/breaker at equipment rack. Protect labels with clear heat shrink.
- H. Label all mixer inputs with their respective input. Example: mixer input 1 – “Mic-1”, etc. Label to reflect name on engraved wall plate.
- I. Solder all microphone connections using rosin core solder. Use temperature controlled soldering equipment. Microphone XLR connectors shall use standard wiring code as follows: pin 1 shield/ground, pin 2 positive, pin 3 negative.
- J. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.
- K. Install equipment cabinet in a controlled temperature, dry and accessible area. Provide sufficient space to completely open the front and rear of the cabinet. Equipment not to be in general gym area where it can be damaged.

### 3.2 CABLING

- A. General: Unless otherwise noted, provide the following cable types (or equivalent) for each application:
1. West Penn 454 #22 AWG twisted pair / shielded for Microphone and Line level signals.
  2. West Penn C210 #10 AWG twisted pair for subwoofer / low frequency speakers.
  3. West Penn 227 #12 AWG twisted pair for conventional, full range sound reinforcement speakers.
  4. West Penn 226 #14 AWG twisted pair for 70v sound reinforcement speakers.
  5. West Penn 810 RG-8 coax cable for analog RF signal lines.
  6. West Penn 4246 CAT6 cable for Local Sound/Video Network and Dante digital audio devices.
  7. West Penn 4246F F/UTP CAT6 for digital audio snake devices.
  8. West Penn 4246AF F/UTP CAT6A cable for HDBaseT video devices.
  9. Crestron CRESNET.
- B. Provide plenum rated cable where required.

### 3.3 INSPECTIONS

- A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.
- B. Ensure all systems are installed to provide uniform, balanced audio coverage throughout each intended listening area. Ensure there are no rattles, buzzes, hums, RF interference, electro-static interference, feedback or other audible audio anomalies while the systems are in operation.
- C. Contractor shall use white / pink noise generator and audio spectrum analyzer to set overall frequency response and equalization. Ensure gain structure is properly set to prevent clipping on any device and to provide balanced system functionality. Provide proper limiter programming to prevent damage to all audio components. District Maintenance personnel to be on site during process.
- D. Demonstrate the performance of each system and give instructions of proper operation and maintenance to the Owner. Provide a minimum of eight hours of training and basic system operating instructions for each system in not more than four hour sessions. Include a list of system training attendees in the Close-Out Documentation.
1. Contactor shall record each training session with a 720p, minimum, digital video recording device, with audible audio, in .MOV or .MP4 format and compile sessions onto 128MB thumb drives (as many as required) (SanDisk, Kingston or PNY) and provide to Owner. Contractor shall title each video file with the room name of the system and date; e.g., "Dining Commons – August 15, 2019."

**END OF SECTION**

## **SECTION 28 13 00 – ACCESS CONTROL SYSTEM**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1- GENERAL**

#### **1.1 RELATED WORK**

- A. The following, in their entirety and as applicable, shall apply to this section, including any associated drawings.
  - 1. Conditions of Contract
  - 2. Division 1
  - 3. Division 26
  - 4. Division 27
  - 5. Division 28

#### **1.2 WORK INCLUDED**

- A. The Contractor shall furnish and install a complete microprocessor based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification. Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. The system shall include Security Card reader access interfaces at all locations noted.
  - 1. The Control System shall be the product of a single manufacturer.
  - 2. Tag all conductors or cables at each end.
  - 3. Installation of modules and cards.
  - 4. Interconnection of security panels.
  - 5. Installation of new security devices.
  - 6. Integration with existing Intrusion Detection and CCTV as required by owner.
  - 7. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
  - 8. Installation of all Card Readers and field devices.
- D. The contractor shall connect this location to the district ACS Management system.
- E. Prior to rough-in or installation of any access control device, Contractor will be required to attend a pre-construction meeting with the Door Hardware installer to aid in coordination and help avoid gap / overlap during the installation phase.
- F. Contractor must be in good standing with the district and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the Contractor's bid.
- G. All structured cabling for data connections for door controllers and vestibule panel to connect to the owner's LAN shall be installed by the structured cabling contractor. Exact location of door controllers will be coordinated between Contractor and the structured cabling contractor.

- H. All power circuits, conduits, penetrations and sleeves required to complete installation of the control system shall be installed by the electrical contractor. Coordination meeting(s) between Contractor and electrical contractor will be required to facilitate installation of conduits, pathways, and power circuits. (Ref. 28-13-00 2.6.A.4 & 28-13-00 2.6.A.5)
- I. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

### 1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Fire Protection Association Standards:
  - 1. NFPA 70 National Electric Code
  - 2. NFPA 72 National Fire Alarm Code
  - 3. NFPA 101 Life Safety Code
- B. Local & State Building Codes
- C. Requirements of Local Authorities having Jurisdiction
- D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
- E. Requirements of American Disabilities Act (Public law 101-336).
- F. Texas Accessibility Standards (T.A.S.)
- G. State Fire Marshall.
- H. Texas Insurance Code.

### 1.4 QUALITY ASSURANCE

- A. System Installer Qualifications:
  - 1. The installing contractor shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
  - 2. The installing contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems.
  - 3. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
  - 4. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
  - 5. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No

- person is allowed to work on the system without proper manufacturer's certification.
6. The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.
  7. Contractor must be a current integrator of the specified solution in the closet major metropolitan area marketplace, have a permanent office located within 75 miles of the project, and be able to include information on current support staff to be able to service this client.
  8. The System Installer must be in good standing with the Owner and have no outstanding performance or warranty item at the time of bid. Any outstanding items or issues are grounds to disqualify the System Installer from performing any work on the project.

## 1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
  1. Control panel wiring and interconnection schematics.
  2. Complete point to point wiring diagrams.
  3. Riser diagrams.
  4. Complete floor plan drawings locating all system devices.
  5. Factory data sheets on each piece of equipment proposed.
  6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
  7. Complete system bill of material.
  8. Line by line specification review stating compliance or deviation.
- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

## 1.6 DEFINITIONS

- A. Abbreviations
  1. ACS: Access Control System
  2. VMS: Video Management
  3. NVR: Network Video Recorder
  4. IDS: Intrusion Detection System
  5. GUI: Graphical User Interface
  6. IP: Internet Protocol
  7. CR: Card Reader
  8. DS: Door Station
  9. MS: Master Station
  10. PIR: Passive Infrared Sensor
  11. LD: Lockdown
  12. MDF: Main Distribution Frame
  13. IDF: Intermediate Distribution Frame
- B. Definitions
  1. Access Card: A coded employee card, usually the size of a credit card, recognizable to the access control system and read by a reader to allow access. It can be used for photo-identification of the cardholder and for other data collection purposes. Card technologies include magnetic strips, Wiegand-effect, proximity (active/passive), barium ferrite, smart/intelligent cards, and NFC enabled applications on mobile devices.
  2. Access Control System: An interconnected set of controllers, managing the entrance and exit of people through secured areas.

3. Access Level: The door or combination of doors and/or barriers an individual is authorized to pass through and the times they are permitted.
4. Anti-Pass back (Anti-Tailgating): This feature protects against more than one person using the same card or number. It defines each system card reader and card ID number as IN, OUT or other. Once a card is granted access to an IN reader, it must be presented to an OUT reader before another IN reader access is granted. Cards will continue to have access to all authorized OTHER readers.
5. Alarm: A signal that indicates a problem.
6. Alarm input: A device that is monitored by the access control panel. An alarm signal will be generated if the device is activated.
7. Badge: Badge is a template or a design for creating a card. DNA Fusion includes a full-featured badge layout utility for designing, creating, and printing badges. Badge design includes magnetic strip encoding, bar coding, signatures, and so on.
8. Bar Code: A method of encoding information using lines and blank spaces of varying size and thickness to represent alphanumeric characters.
9. Biometrics: A general term for the verification of individuals using unique biological characteristics (i.e. fingerprints, hand geometry, voice analysis, the retinal pattern in the eye).
10. Card and Card Holder: A card is an identity proof of a person, and a card holder is a person who holds the card. Multiple cards can be assigned to a single card holder to provide different access.
11. Controller: A microprocessor-based circuit board that manages access to a secured area. The controller receives information that it uses to determine through which doors and at what times cardholders are granted access to secure areas. Based on that information, the controller can lock/unlock doors, sound alarms, and communicate status to a host computer.
12. Card Reader: A device that retrieves information stored on an access card and transmits that information to a controller.
13. Digital Video Recorder: A security system device that records the video from the surveillance cameras (IP and Analog) on a hard disk.
14. Door: A generic term for a securable entry way. In many access control applications, a "door" may be a gate, turnstile, elevator door, or similar device.
15. Duress: Forcing a person to provide access to a secure area against that person's wishes.
16. Input: An electronic sensor on a controller that detects a change of state in a device outside the controller.
17. Integrated lockset: An integrated, intelligent locking solution that typically runs on batteries, but can be externally powered, that contains most of the door components, i.e. reader, door contact, and request to exit in a single, mountable unit.
18. Keypad: An alphanumeric grid which allows a user to enter an identification code. A flat device which has buttons that may be pressed in a sequence to send data to a controller, and which differs from a typewriter-like computer keyboard.
19. Output Relay: A device that changes its state upon receiving a signal from a controller. Typically, the state change prompts an action outside of the controller such as activating or deactivating a device. The auxiliary relays found in access control panels or NODES that control external devices.
20. Shunt Time: The length of time a door open alarm is suppressed (shunted) after a valid card access or free egress request. This time should be just enough to allow a card user to open a door or gate, pass through, and then close it.
21. Time Schedules: Schedules that allow cards to function or not function depending on the time of day. This is used to limit access to the facility. The schedule may include not only time but which days of the week a card is valid.
22. Video Management System: An enterprise-class video management and storage Solution



### **1.7 PRE-INSTALLATION MEETINGS**

- A. No less than a minimum of two weeks prior to rough-in or installation of any access control device, the ACS Installer will be required to attend a pre-construction meeting with the Door Hardware provider / installer to aid in coordination and help avoid gap / overlap during the installation phase.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

### **1.9 PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

### **1.10 SEQUENCING**

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

### **1.11 WARRANTY**

- A. The ACS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS**

- A. AMAG Technology Inc  
20701 Manhattan Place  
Torrance, Ca 90501  
(310) 518.2380  
<http://www.amag.com>
- B. Requests for substitutions will be considered in accordance with provisions of Division 1. In the absence of direction by Division 1, substitution requests must be submitted no less than ten (10) business days from the time of proposal. Any substitution proposed will have to be proposed as a complete system replacement across the Owner's entire platform, including any cabling and/or hardware changes required to convert all the Owner's existing sites.

### **2.2 PERIMETER AND INTERIOR DOOR CONTROL PANELS**

- A. Door Control Panels are to be installed as needed in MDF/IDF rooms throughout the campus, to provide communications and power for access control devices in the area of influence of each IDF
- B. All hardware is to be mounted in an Altronix Trove 2 enclosure with RSB2 switch plate. Panel must have a provided emergency power circuit to the RB2 switch panel to enable ease of power shut off for the power supply by one switch and main panel transformer on the secondary

switch.

- C. One (1) Intelligent Door Controller and door Sub Controllers shall be populated in the Altronix enclosure sufficient to provide access controls for all doors to be controlled from the IDF, for a minimum eight (8) doors. The Intelligent Controller shall be IP-based. Sub Controllers should connect to the Intelligent Controller via network or RS-485 Data Bus.
- D. An Altronix eFlow 10XNB power supply is required to be provided and installed along with a PDS8CB or PD16W Power Distribution Module and ACM8CB Access Power Controller. A (1) VR6 regulator in the enclosure to provide correct power distribution.
- E. Two Category 6 network drops are required within the panel for local configuration of system with laptop and primary panel communication. Each drop should be properly labeled per network cabling guidelines.
- F. Panel IP network configuration information shall be provided by the owner.
- G. Final software configuration / programming of the system integration will require owner / contractor consultation.
- H. System Back-Up Battery: The System Installer shall provide backup batteries as required to furnish ninety (90) minutes of run time to the complete system, including but not limited to lock power and system power.

### 2.3 PERIMETER FENCE GATES

- A. Access Controlled gates shall be connected to an IP-based Door controller which may be installed near the building perimeter wall, closest to the gate, to provide additional cabling distance.
- B. Door Controller will require network data drop provided by Division 27 contractor interior of the building. To provide communications and power for the access-controlled devices.
- C. Location will require Access control power supply unit at controller location on dedicated emergency power circuit. All 120v Power shall be furnished by the Division 26 contractor. In the event a Division 26 contractor is not contracted for the project, the system installer shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.
- D. Proper surge arrestment devices must be employed if installation requires underground cabling to be utilized.
- E. Reader module on fence gate shall be Schlage # PR10.
- F. Lock assembly shall be HES 9600 Series electric strike with suitable outdoor rating and door position switch monitoring capability. Door position switch to be tied into intrusion system for monitoring purposes.

### 2.4 VEHICLE ACCESS GATES

- A. Access Controlled gates shall be connected to an IP-based 2-Door controller which may be installed near the building perimeter wall, closest to the gate, to provide additional cabling distance.
- B. 2N Video Intercom (w/Wiegand and Proximity reader module) to be installed on pedestal via Pedestal Pro part # HJO-PRO-0010-CRS-B housing for access control entry through controlled vehicle gate. Exterior gate housing will require use of 2N part # 01285-001 to complete installation correctly.
- C. All gates must have a Tagmaster XT-1 RFID reader installed as the secondary for utilization of district vehicle tag system.
- D. Tagmaster installation and testing must be done with Owner on site to confirm configuration.
- E. Consultation is required with the owner to determine if additional Vehicle Tags will be required at the time of installation and the amounts needed.

## 2.5 FIELD DEVICES

- A. Card Access Equipment
1. All Card Readers locations to be installed on walls or pedestrian gates shall be PR10 card readers as manufactured Schlage.
  2. All Card Readers locations to be installed on doors shall be SN200 series readers as manufactured by Sargent.
  3. Access Control contractor shall provide ALL electronic components required for a complete and functioning access control system, to include card reader, door contact, lock power supply, electrified locking device with integrated request to exit, power transfer hinge and wiring harnesses. The door hardware contractor shall be responsible for non-electrified, mechanical door hardware.
  4. Access Control contractor shall provide all cabling required for connection to any device incorporated and not incorporated in door hardware.
  5. Contractor shall provide 300 HID proximity cards 1386 Series for this campus. CFISD has a Corporate 1000 account set up with HID. The contractor shall purchase cards through HID using this account to ensure card numbers and facility numbers are followed.
  6. Provide Ethernet Network Interface to connect school to district-wide access control system. Connect to local area network at each facility.
  7. Contractor shall provide all cabling and accessories required to provide complete access control solution and proper integration with building intrusion alarm system for door contact shunting.
  8. All called for release buttons shall be United Security Products #HUB2SA momentary under counter release switch.
  9. Provide all door controllers as required to connect all perimeter card reader locations shown on plan plus one additional of each type for attic stock.

## 2.8 WIRING

- A. Access Control Contractor shall provide and install Access Control system cabling.
1. Color code of all security intrusion detection system and access control wiring shall be purple in color.  
Approved products: Lake Composite Access Control Cable: S800081709-07
  2. Ethernet cabling to access control panels shall be as specified in the Structured Cabling System (SCS) specifications and shall be provided by the SCS Installer. In the event there is not SCS installer on the project, cabling shall be provided and installed by the ACS Installer and shall comply with the Division 27 SCS specification. Minimum of Category 6 cable shall be utilized if not specified otherwise.
  3. All systems shall be connected to a dedicated circuit and on an emergency power source.
  4. All 120v Power shall be furnished by the Division 26 contractor. In the event a Division 26 contractor is not contracted for the project, the system installer shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.
  5. All Security Conduit as required for a complete installation of this system shall be furnished by the Division 26 contractor as part of their scope of work. In the event a Division 26 contractor is not contracted for the project, the system installer shall provide and install all conduit required.
  6. Coordination with the Division 26 contractor is the responsibility of the ASC installer to ensure all conduit is in place for a complete installation.

## **PART 3- EXECUTION**

### **3.1 INSTALLATION**

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors traversing the respective box as well as the number of terminations required.
- H. Network Connection Cable: Provide a Category 6 data cable from the Master Control Panel/Node to the MDF network rack. Category 6 cable shall be purple in color.
- I. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated Velcro ties and J-Hooks. (Ref. 28-13-00 3.3.A)
- J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

### **3.2 CABLE PATHWAYS**

- A. Cable Support:
  - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
    - a. Approved Cable Support Product:  
PANDUIT® Corporation J-MOD™ modular support system (sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per support size.)
  - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the threaded rod.
  - 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.

4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
  5. ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.
  6. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.
- B. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
  2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
  3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
  4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
  5. All conduit ends shall have a protective bushing to prevent cable damage. BUSHINGS MUST BE INSTALLED PRIOR TO INSTALLING CABLE. CUTTING BUSHING TO INSTALL AROUND INSTALLED CABLES WILL NOT BE ACCEPTED.

### **3.3 TESTING**

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor, Door Hardware Installer, and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.

### **3.4 WARRANTY**

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.
- B. Installed main system devices must be awarded the same warranty provided to the installer by the Manufacturer of the product.

### **3.5 SOFTWARE**

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

**END OF SECTION**

## **28 15 23.17 - AUDIO-VIDEO DOOR INTERCOM SYSTEM**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 RELATED WORK**

- A. Section 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

#### **1.2 SYSTEM DESCRIPTION**

- A. General Requirements
1. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
  2. The specified unit shall be based upon standard components and proven technology using open and published protocols.
- B. Sustainability
1. The specified unit shall be manufactured in accordance with ISO 14001.
  2. The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
  3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).

#### **1.3 CERTIFICATIONS AND STANDARDS**

- A. General abbreviations and acronyms
1. AES: Advanced Encryption Standard
  2. API: Application Programming Interface
  3. Bit Rate: The number of bits/time unit sent over a network
  4. DHCP: Dynamic Host Configuration Protocol
  5. DNS: Domain Name System
  6. FPS: Frames per Second
  7. FTP: File Transfer Protocol
  8. H.264 (Video Compression Format)
  9. IEEE 802.1x: Authentication framework for network devices
  10. IP: Internet Protocol
  11. IR light: Infrared light
  12. ISO: International Standards Organization
  13. JPEG: Joint Photographic Experts Group (image format)
  14. LAN: Local Area Network
  15. LED: Light Emitting Diode
  16. MPEG: Moving Picture Experts Group
  17. Multicast: Communication between a single sender and multiple receivers on a network
  18. NTP: Network Time Protocol
  19. ONVIF: Global standard for the interface of IP-based physical security products
  20. PACS: Physical Access Control System
  21. PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
  22. Progressive scan: An image scanning technology which scans the entire picture
  23. QoS: Quality of Service
  24. RPC: Remote Procedure Call
  25. SIP: Session Initiation Protocol
  26. SMTP: Simple Mail Transfer Protocol
  27. SNMP: Simple Network Management Protocol

28. SSL: Secure Sockets Layer
29. TCP: Transmission Control Protocol
30. TLS: Transport Layer Security
31. Unicast: Communication between a single sender and single receiver on a network
32. UPS: Uninterruptible Power Supply
33. VBR: Variable Bit Rate
34. VMS: Video Management System
35. WDR: Wide dynamic range

B. The specified unit shall carry the following EMC approvals:

1. EN55032: 2012
2. EN55024: 2010
3. 2014/35/EU
4. 2014/30/EU
5. 2012/19/EU
6. 2011/65/EU
7. EN 55032 Class A
8. EN 55032 Class B
9. EN 55024
10. FCC Part 15 - Subpart B Class A
11. FCC Part 15 - Subpart B Class B
12. FCC Part 15 - Subpart B Class A + B
13. ICES-003 Class A
14. ICES-003 Class B

C. The specified unit shall meet the following product safety standards:

1. IEC/EN/UL 60950-1

D. The specified unit shall meet the following standards

1. Audio:
  - a. G.711
  - b. G.729
  - c. G.722 (wideband)
  - d. L16 / 16kHz (wideband)
2. Video:
  - a. H.263+
  - b. H.263
  - c. H.264 (MPEG-4 AVC)
  - d. MPEG-4 Part 2
  - e. MJPEG
3. Networking:
  - a. IEEE 802.3af/802.3at (Power over Ethernet) [applies to products with PoE]
  - b. IEEE 802.1X (Authentication)
  - c. IPv4 (RFC 791)
  - d. QoS
4. Mechanical Environment:
  - a. IEC/EN 60529 IP54
  - b. IEC/EN 62262 IK08

#### 1.4 QUALITY ASSURANCE

- A. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.

- B. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- C. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
- D. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
- E. The specified unit shall be manufactured in accordance with ISO9001.

### 1.5 WARRANTY

- A. All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years start from the date of substantial completion.
- B. The manufacturer shall provide warranty and optional extended warranty for the unit for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

## PART 2 – PRODUCTS

### 2.1 GENERAL

- A. Intercoms shall be IP-based and comply with established network and video standards.
- B. Intercoms shall be powered by the switch utilizing the network cable.
- C. Intercoms shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

### 2.2 INTERCOM SCHEDULE

- A. Intercom types listed below describing various resolutions, form-factor and features shall be supplied by a single intercom manufacturer.
- B. The intercom manufacture and model numbers will be as follows:
  - 1. Modular IP intercom shall be 2N IP Verso with camera. Part # 02907-001
    - a. 2N IP intercom Gold License Required. Part # 01380-001
  - 2. IP intercom base station shall be 2N Indoor View #02088-001
    - a. 2N Base station stand required. Part # 02039-001
  - 3. 2N Combo Reader Module. Part # 02778-001
  - 4. 2N Secure Door Set Tamper. Part # 01975-001
  - 5. 2N Weigand Module. Part # 01259-001
  - 6. 2N Surface frame plate. Part # 01289-001
  - 7. 2N Surface back plate. Part # 01294-001

### 2.3 INTERCOM

Modular IP intercom



- A. The intercom shall meet or exceed the following design specifications:
  - 1. The intercom shall include a built-in web server.
  - 2. The intercom shall be able to perform defined local access control functionality without being connected to the network.
  - 3. The intercom shall be of modular design, include a replaceable front-end frame, providing 1 or 2 additional slots for functional modules, and should support multiple frames stacked side by side. The intercom shall support at least 29 functional modules when fully expanded.
  - 4. The intercoms' main unit shall be available with and without camera, and shall support the following functional modules:
    - a. RFID card reader
    - b. Fingerprint reader
    - c. Keypad
    - d. Button module
    - e. Touch screen
    - f. Bluetooth
    - g. Wiegand interface
  - 5. The intercom shall be equipped with an IR-sensitive progressive scan megapixel sensor and be able to provide images also under dark conditions.
  - 6. The intercom shall be equipped with built-in power adaptive IR-illumination/LED.
  - 7. The camera shall provide an automatic IR-cut filter, providing day/night functionality.
- B. The intercom shall meet or exceed the following performance specifications:
  - 1. Video
    - a. The intercom shall provide video streams in 640x480 at up to 30 frames per second using H.264, H.263, H.263+ or up to 15 frames per second using MJPEG.
    - b. The intercom camera shall provide images in resolutions up to 1280x960.
    - c. The intercom shall support the following video encoding algorithms:
      - 1) H.263+
      - 2) H.263
      - 3) H.264
      - 4) MPEG-4 Part 2
      - 5) MJPEG
    - d. The intercom shall provide independently configured simultaneous H.264 and MJPEG streams.
    - e. The intercom shall in H.263, H.263, H.264 support Constant Bit Rate (CBR) to protect the network from unexpected bit rate peaks.
    - f. The intercom shall provide configurable compression levels.
    - g. Support standard baseline profile H.264 with motion estimation.
    - h. Support motion estimation in H.264/MPEG-4 Part 10/AVC.
    - i. The intercom shall allow for video to be transported over:
      - 1) HTTP (Unicast)
      - 2) HTTPS (Unicast)
      - 3) RTP (Unicast & Multicast)
      - 4) RTP over RTSP (Unicast)
      - 5) RTP over RTSP over HTTP (Unicast)
    - j. The intercom shall support Quality of Service (QoS) to be able to prioritize traffic.
  - 2. Image
    - a. The camera shall incorporate automatic white balance.
    - b. The camera shall support manually defined values for:
      - 1) Color level
      - 2) Brightness
  - 3. Audio
    - a. The intercom shall support two-way full duplex audio:
    - b. Input sources

- 1) Internal microphone
  - c. Output sources
    - 1) Built-in speaker, 2W
    - 2) Line out
  - d. The intercom shall support separately adjustable volume levels for:
    - 1) Call
    - 2) Key
    - 3) Ring tones
    - 4) Preloaded audio clips
    - 5) Warning tones
    - 6) Paging
  - e. The intercom shall support adaptive gain control.
  - f. Encoding: The intercom shall support:
    - 1) G.711
    - 2) G.722 (wideband)
    - 3) G.729
    - 4) L16 / 16kHz (wideband)
  - g. The intercom shall provide a sound pressure level of at least 78dB at 1kHz at 1m.
  - h. The intercom shall be equipped with active echo cancellation.
  - i. The intercom shall allow for audio to be transported over:
    - 1) RTP (Unicast & Multicast)
    - 2) RTP over RTSP (Unicast)
    - 3) RTP over RTSP over HTTP (Unicast)
  - j. The intercom shall support Quality of Service (QoS) to be able to prioritize traffic.
4. Call functionality.
- a. The intercom shall support SIP for integration with VoIP, peer-to-peer or integrated into SIP/PBX.
  - b. The intercom shall support the use of SIP Proxy, which can be the same as the SIP registrar for outgoing calls.
  - c. The intercom shall support dialing up to twelve separate numbers in sequence or as ring group.
5. Access control functionality
- a. The intercoms' reader outputs shall be wired through the Weigand module to the existing access control system.
6. User Interface
- a. Web server
    - 1) The intercom shall contain a built-in web server making functionality and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
  - a. IP addresses
    - 1) The intercom shall be set with dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    - 2) The intercom shall allow for automatic detection of the intercom based on WS Discovery when using a computer with an operating system supporting this feature.
    - 3) The intercom shall provide support for IPv4.
2. Event functionality
- a. The intercom shall be equipped with an integrated event functionality, which can be triggered by:
    - 1) Tamper / case open
    - 2) SIP Call state incl. incoming call
    - 3) Change of SIP registration status
    - 4) Video Motion Detection

- 5) Noise Detection
  - 6) SIP DTMF sequences
  - 7) External input
  - 8) Access control events such as code, card, fingerprint entered
  - 9) Predefined time
  - b. Response to triggers shall include:
    - 1) Send notification, using HTTP or email
    - 2) Activate sound alarm
    - 3) Make or end call
    - 4) Send notification, using HTTP, HTTPS, Wiegand or email
    - 5) Send images, using FTP or email
    - 6) Activating external output
    - 7) Play audio clip
3. Protocol
- a. The intercom shall incorporate support for at least HTTP, HTTPS, SIP 2.0, TFTP, RTSP, RTP, SMTP, DHCP opt 66, NTP, Syslog.
  - b. The SMTP implementation shall include support for SMTP authentication.
  - c. The camera shall incorporate support for at least IPv4, HTTP, HTTPS, SIP, SSL/TLS, QoS Layer 3 DiffServ, TCP, ICMP, SNMPv2c, RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, ARP, DNS, NTP,
4. Security
- a. The intercom shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
  - b. The intercom shall block its login page for 30 seconds after three faulty passwords have been submitted.
  - c. The intercom shall force user to change admin password upon first installation.
  - d. The intercom shall provide centralized certificate management, with the ability to upload CA certificates. The certificates shall be signed by an organization providing digital trust services.
  - e. The intercom shall support IEEE 802.1X authentication.
  - f. Selected services, such as RTSP or web config shall be configurable to only allow access from local devices.
  - g. The intercom shall restrict access to the built-in web server by username and password.
  - h. The intercom shall be equipped with tamper detection.
5. API support
- a. The intercom shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
  - b. The intercom shall conform to ONVIF profile S as defined by the ONVIF Organization.
    - 1) For ONVIF profile specifications, see [www.onvif.org/](http://www.onvif.org/)
  - c. The intercom shall be interoperable/certified with major PBX and gateway manufacturers, including:
    - 1) Cisco
    - 2) Avaya
    - 3) Broadsoft
6. Installation and maintenance
- a. The intercom shall support secure configuration using HTTPS.
  - b. The intercom shall support the use of SNMP-based management tools according to SNMP v2c.
  - c. The intercom shall allow updates of the software (firmware) over the network, using TFTP, HTTP or web interface.
  - d. The intercom shall be time synchronized to the district NTP (Network Time Protocol) server.

- e. The intercom shall support back-up and restore of configuration.
  - f. The intercom shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
7. Access log
- a. The intercom shall be able to log events such as codes, phone calls, RFID cards etc., and provide them using HTTP interface for monitoring.
  - b. The administrator shall be able to set whether the particular messages are sent by the intercom immediately after any event occurs, or if the client registers for event logging and then asks for full report since last registration, all events at once.
  - c. The client shall be able to select which messages are reported from event log.
8. Intercom diagnostics
- a. The intercom shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the intercom's operational status and provide information about power, the network status and the intercom status.
  - b. The intercom shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
9. Hardware interfaces
- a. Network interface
    - 1) The intercom shall be equipped with one 10BASE-T/100BASE-TX Fast Ethernet-port, using a standard RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
  - b. Doors
    - 1) The intercom shall be equipped with programmable input supporting both short circuit activation or up to +30VDC for door monitor or Request to Exit (REX).
    - 2) The intercom shall be equipped with two independent outputs for door control. One active providing at least 8VDC / 400mA and one NO/NC relay supporting up to 30V AC/DC 1A.
  - c. Audio
    - 1) The intercom shall be equipped with line output.
  - d. Power
    - 1) The intercom shall be equipped with a removable terminal block providing connectivity for external power.
  - e. Multifunctional connector
    - 1) The camera shall, by using a "multi wire ribbon cable", provide connectivity between main unit and modules.
10. Enclosure
- a. The intercom shall:
    - 1) Be manufactured with IP54 rated housing, and be IK08 (IK07 when using Touchscreen module).
    - 2) Be fitted with a tamper switch.
    - 3) Be of modular design, supporting main unit and up to 29 additional modules.
    - 4) Be available in black and brushed nickel versions.
11. Power
- a. Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 0
  - b. 12 V DC
    - 1) Max: 2A
12. Environmental
- a. The intercom shall:
    - 1) Operate in a temperature range of -40° C to +60° C (-40° F to 140° F)

### PART 3 - EXECUTION

**3.1 INSTALLATION**

- A. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate complete system.
- B. All equipment shall be configured in accordance with instructions provided by the manufacturer and systems administrator prior to district inspection.
- C. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer.
- D. The contractor shall provide a 2N Indoor Touch 2.0 master station at the primary operator's desk with its appropriate stand.
- E. Contractor is responsible for working with other trades to ensure proper installation of all devices per recommended codes.
- F. All equipment requiring users to log on using a password shall be configured with district specific password. No system/product default passwords shall be allowed.

**END OF SECTION**

## SECTION 28 16 00 – INTRUSION DETECTION SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### PART 1- GENERAL

#### 1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
  - 1. General Conditions
  - 2. Supplementary Conditions
  - 3. Division 1
  - 4. Division 26 in its entirety.
  - 5. Division 27 in its entirety.
  - 6. Division 28 in its entirety.

#### 1.2 WORK INCLUDED

- A. The Contractor shall furnish and install a complete microprocessor based Intrusion Detection System (IDS) as specified herein. The IDS shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. IDS devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. The IDS shall include intrusion detection coverage as shown on the system floor plans. Whether shown on the floor plans or not, complete coverage of the following areas shall be included:
  - 1. All access points into the building(s), including but not limited to:
    - a. Doors
    - b. Roof Hatches
    - c. Windows
  - 2. Interior space motion detection at the following locations:
    - a. All Level I spaces with window and/or doors
    - b. All entrances on any level
- D. The IDF shall be the product of a single manufacturer and consist of, but not limited to the following:
  - 1. Control Panels
  - 2. Field Devices
  - 3. Enclosures
  - 4. Locks and Keys
  - 5. Power Supplies
  - 6. Accessories required to provide a complete IDS System Programming
- E. The IDS installer shall be responsible for, but no limited to:
  - 1. Tagging all conductors or cables at each end.
  - 2. Installation of IDS panels.
  - 3. Interconnection of IDS panels
  - 4. Installation of new IDS devices.
  - 5. Full coverage of all windows, doors, roof hatches.
  - 6. Preconstruction meeting with Owner's personnel, installing technician and project

superintendent.

- F. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.
- G. The Contractor shall be responsible for identifying requirements for permits, from the local the Local Authority Having Jurisdiction (AHJ), for the installation of the alarm system specified herein and shall assist the Owner in obtaining the relevant alarm permits.
- H. All conduits and back boxes shall be provided and installed by the project's electrical contractor. In the event that no electrical contractor is on the project, responsibility will be that of the IDS installer.
- I. Contractor shall integrate all Emergency Eyewash systems into the IDS. Provide cabling connecting both systems. Coordinate with Emergency Eyewash systems contractor.
- J. Contractor shall connect the Intrusion Detection System to the electrical automatic transfer switch in order to notify the District Police Department when the building is on emergency power. Provide all required cabling and devices for fully functional systems.

### 1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Electric Code, Article 760.
- B. National Fire Alarm Code (NFPA 72).
- C. Life Safety Code (NFPA 101)
- D. Administrative Council for Terminal Attachments (ACTA):
  - 1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.
- E. American National Standards Institute(ANSI):
  - 1. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- F. California State Fire Marshal (CSFM):
  - 1. Title 19, California Code of Regulations, Building Material Listing Program (BML).
- G. Federal Communications Commission (FCC):
  - 1. Title 47 C.F.R. Part 15; Class B – Radiated and Conducted Emissions.
  - 2. Title 47 C.F.R. Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network(PSTN).
- H. The National Institute of Standards and Technology of the United States of America (NIST):
  - 1. Federal Information Processing Standards Publications 197 (FIPS 197) –Advanced Encryption Standard (AES).

- I. International Organization For Standardization (ISO):
  - 1. 9001 - Quality System.
  
- J. Underwriters Laboratories, Inc. (UL):
  - 1. UL 50 - Enclosures for Electrical Equipment.
  - 2. UL 294 – Access Control System Units.
  - 3. UL 365 - Police Station Connected Burglar Alarm Units and Systems.
  - 4. UL 609 - Local Burglar Alarm Units and Systems.
  - 5. UL 864 - Control Units System for Fire-Protective Signaling System.
  - 6. UL 985 - Household Fire Warning System Units.
  - 7. UL 1023 - Household Burglar Alarm System Units.
  - 8. UL 1076 – Proprietary Burglar Alarm Units and Systems
  - 9. UL 1610 - Central Station Burglar-Alarm Units.
  - 10. UL 60950-1 - Information Technology Equipment - Safety.
  - 11. UL 636 – Hold up alarms
  
- K. Local & State Building Codes
  
- L. Requirements of Local Authorities having Jurisdiction
  
- M. Requirements of American Disabilities Act (Public law 101-336).
  
- N. Texas Accessibility Standards (T.A.S.)
  
- O. State Fire Marshall.
  
- P. Texas Insurance Code.

#### 1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
  - 1. The installing contractor shall be the authorized representative of the IDS authorized/certified to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the IDS manufacturer's product for at least five (5) years.
  - 2. The installing contractor shall be certified to install and setup the IDS software with Security Engine and Access Engine Modules attached.
  - 3. The installing contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems and access control system.
  - 4. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained servicetechnicians.
  - 5. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
  - 6. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the specified IDS. No person is allowed to work on the IDS without proper manufacturer's certification.

#### 1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
  - 1. Control panel wiring and interconnection schematics.
  - 2. Complete point to point wiring diagrams.



3. Riser diagrams.
  4. Complete floor plan drawings locating all system devices.
  5. Factory data sheets on each piece of equipment proposed.
  6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
  7. Complete system bill of material.
  8. Line by line specification review stating compliance or deviation.
- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS**

- A. Acceptable Manufacturer: Bosch Security Systems, Inc.; 130 Perinton Parkway; Fairport, NY 14450. ASD. Toll Free Tel: 800-289-0096. Tel: 585-223-4060. Email: request info (presales.support@us.bosch.com). Web: www.boschsecurity.us.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of section 01600.

### **2.2 CONTROL COMMUNICATOR (Panel)**

- A. The IDS control panel shall be Bosch Security Systems, Inc., model # B9512G comprising a fully integrated intrusion, fire, and access control system. The control panel shall support the following:
1. The IDS system is capable of being utilized as a combination Intrusion and Fire system per code. Fully integrated intrusion, access and fire functions allow users to interface with 1 system instead of 3
  2. Telephone Line Module Interface with programmable options for signaling and supervision.
  3. Conettix IP based communication option provides high-speed, secure alarm transport and control.
  4. 32 programmable areas with perimeter and interior partitioning.
  5. 8 on-board, class B hardwired points with expansion capability for a total of 500 wired or wireless points.
  6. Compatibility with touch-screen color LCD, vacuum fluorescent, ATM style LCD or LED style Alarm Command Centers.
  7. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
  8. The system shall support the use of an Apple iOS device for control. Functions to include arming, disarming, control of outputs, lock, unlock, cycle and secure access doors.
  9. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
  10. Provide 1.4 amps of power for standby operation and 2 amps of alarm power, both rated at 12 VDC.
  11. 2 wet-contact relay outputs and 1 Auxiliary wet-contact relay output with expansion capability for up to an additional 128 dry-contact relay outputs.
  12. Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
  13. Supervision of peripheral devices and communications interface(s).

- B. All small installations such as press boxes or tractor sheds shall use Bosch Model #5512 main control panel.
- C. Programmable features shall include:
  - 1. Independently control zones through an independent zone control keypad.
  - 2. Two telephone number dial up for primary and secondary remote receivers.
  - 3. Automatic test reports.
  - 4. Selective zone shunting.
  - 5. Custom text on the associated command centers.
- D. Zone Expansion - Expanded to 500 (8 on-board, 492 off-board) individually annunciated points of protection through the addition of a two-wire multiplex zone expansion system (ZONEX). Points of protection are annunciated with custom text at the D1255B Alpha Command Center and they can be reported to a Radionics D6600Receiver.
- E. User Pass Codes – nine hundred ninety-nine (999) user pass codes shall be available to identify the user when arming/disarming the system.
- F. Protective Circuits shall consist of zones designed for fire and/or panic (holdup, duress, or emergency) and/or burglary and/or supervisory. Each zone represents a protective circuit and shall accommodate normally opened and closed devices with end-of-line resistor supervision. Each of the 500 points are programmable as to whether they are controlled versus 24 hours; interior versus perimeter; instant versus delayed; silent versus audible (and if audible, pulsed or steady); and local or reporting.
  - 1. Additional programmable parameters for each point include the ability to suppress trouble or restoral reports, designate it as a priority zone (system cannot be armed if this point is off-normal), report two separate telephone numbers and provide for automatic shunting of points from the system in the event that the detection device malfunctions and creates numerous false alarms.
  - 2. Each POPIT shall accommodate normally opened and normally closed devices with end-of-line resistor supervisor.
  - 3. Minimum total points, 500.
- G. Entry/exit delays shall be independently programmable from 10 to 150 seconds. A pre-warn audible shall be coincident with the entry delay.
- H. Programming of all system functions shall be achievable at system site or remotely via the use of the dial-up telephone network. Minimum programmable functions shall include:
  - 1. User pass codes, entry/exit delay times, master zone personality, day/date/time, telephone numbers, point of protection text labels, and bell time.
  - 2. A programmable system pass code shall be used to prevent unauthorized remote programming attempts.
  - 3. Remote programming capability shall be automatic or require user enabling at the discretion of the user.
- H. Remote control via the use of the dial-up telephone and owner's local area network shall include:
  - 1. System arming.
  - 2. Reset of audible signals.
  - 3. Activation/deactivation of relay contacts.
  - 4. Interrogation of battery.
  - 5. Zone and armed status.
  - 6. Enable/disable of reporting functions and removing reporting devices for servicing while the remainder of the system is operative.
- I. Recognitions shall include: UL for central station fire and/or burglary, local burglary and/or fire; FM

for fire, California Fire Marshal for fire; and NYBSA for fire.

- J. Miscellaneous built-in features shall include:
  - 1. Real-time clock.
  - 2. Interrogator.
  - 3. Auto-answer modem.
  - 4. Phone line monitor.
  - 5. Loop start/ground start telephone interface.
  - 6. Auto bell test.
  - 7. Lug-in terminal strips, and user controlled zone bypass.
  
- K. Command centers shall be microprocessor-based, UL listed
  - 1. 16 character illuminated alpha-numeric display.
  - 2. Burglary and fire sounders.
  - 3. Backlight 15-key touchpad.
  - 4. Pre-warn tone.
  - 5. The arming station shall have the ability to annunciate the English language format via the 16 character alphanumeric display by the following:
    - a. Master zone (alarm, service, faulted, and function), POPIT (alarm, service, faulted, missing, extra, function, and location), arm/disarm status (system diagnostics, time/day/date, and user prompts).
  - 6. Additional features shall include local system test, sensor reset, panic and/or medical and/or duress alarm initiation, independent master zone by-pass with automatic restoration to normal status to next system arming, perimeter watch mode, user changeable pass codes, remote programming initiation, and system/monitoring service test.
  - 7. Radionics model B915 shall be functional at each of the locations shown on the floorplans.
  - 8. Non-school oriented buildings will use Radionics Model B942 Touch Screen Keypads,
  
- L. Modules and Accessories
  - 1. POPEX Module (Zone Expansion B299)
  - 2. B8103 Main Panel Enclosure & D101 Lock set- one required for the main panel and one for each quadrant of the project receiving a B299.
  - 3. D9002-5 6 location 3 hole Mounting plate- adapter used for hanging modules in all expansion panels.
  - 4. B430 Telephone Line Interface
  - 5. B308 Octo-Relay module - provides eight form "C" dry contact relay outputs for a variety of programmable responses to alarm, trouble and other system conditions.
  - 6. Auxiliary power supplies as required for powering of motion detectors, Altronix Power Supply (Part # SMP10PM12P8) - one required for each quadrant of the project receiving a B299.

## 2.3 FIELD DEVICES

- A. Ceiling mounted 360 degree, infrared sensors / microwave motion sensors. Model DS 9370
  - 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
  - 2. All units must be adjusted/masked to reduce false signals for the covered area.
  - 3. Contractor to provide a dedicated POPIT for each motion detector on the project.
  
- B. Ceiling mounted 200ft Long Range infrared sensor. Model DS794Z
  - 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
  - 2. All units must be adjusted/masked to reduce false signals for the covered area.
  - 3. Contractor to provide a dedicated POPIT for each motion detector on the project
  
- C. Wall mounted, high performance, Tri Tech PIR/Microwave sensor, Model ISC-CDL1-W15G.
  - 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.

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2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
  3. Provide model correct protective wire cage in gymnasiums.
  4. Contractor to provide a dedicated POPIT for each motion detector on the project.
- D. Magnetic Door / Hatch / Overhead Contacts
1. Recessed contact shall be Bosch ISN-CSD70-W to be used in all storefront door frames. 1840-N magnet or like to be used in locations where door frame dictates its necessity.
  2. Surface mount contacts are to be Bosch ISN-CSM35W or appropriate color to match the frame.
  3. Mechanical Door / Roof Hatch contacts shall be model Sentrol 2505A-L contact. The leads must pass through a back box by the correct size twin screw cable clamp connector.
  4. Overhead Roll up contacts shall be model Ademco 958 contact
  5. Contractor to provide a dedicated POPIT for each entry door or set of doors on the project.
- E. Glass Break Detector
1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
  2. Provide model correct protective wire cage in gymnasiums.
  3. Glass Breaks shall be GE Model 5812-RND or Bosch DS-1108DI.
  4. Contractor to Provide dedicated POPIT for each room of glass break detectors on the project.
- F. Sirens
1. Shall be installed on Wall / Ceiling within 50 feet of every keypad location.
  2. Wired directly to corresponding relay module and not the main control panel.
  3. Sirens shall be Model SSX-52 Amseco

## 2.4 WIRING

- A. All wiring shall comply with the manufactures (Bosch/Radionics) specifications. Cabling shall be shielded if required by manufacturer.
- B. Each area of a building shall provide its own Popex Module(s), Power supply(ies) and enclosure(s) in that area's IDF. All areas considered should be at minimum 500ft from the main panel or as otherwise instructed by owner.
- C. Coordination with the contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- D. All systems shall be connected to an emergency power source.
- E. Color code of all security intrusion detection system and access control wiring shall be purple in color.  
Approved Products:
  1. 18/2 unshielded:  
Belden #6300UE 0071000  
Tappan Wire & Cable, Inc. #P40020.122
  2. 18/4 unshielded:  
Belden #6302UE 0071000  
Tappan Wire & Cable, Inc. #P41387.28
  3. 18/6 unshielded:  
Belden #6304UE 0071000

Tappan Wire & Cable, Inc.

### **PART 3- EXECUTION**

#### **3.1 INSTALLATION**

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and Article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" not to exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations such as inside walls, all mechanical / electrical rooms, or other areas where wiring might be exposed or subject to Damage.
- G. All vertical wiring and all main trunk / riser wiring shall be installed in a complete raceway / conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Provide a Green Systimax Category 6 telephone cable from the Master Control Panel to the Telephone Equipment room.
- I. Two (2) 18-4 wires will be run from the panel to the prior designated future portable connection location and labeled in plain English on both ends. These spares are to be left above the ceiling with a 10' service loop.
- J. Each set of glass breaks that protect one room are to be connected through one POPIT module for point identification of that room.
- K. Magnetic door contacts protecting separate hallways or entries are to be connected into separate POPIT modules for separate identification.
- L. Provide and install (1) dedicated POPIT for each device installed on the project including, but not limited to glass break detectors.
- M. All POPIT Modules shall be installed inside a 4"x4" junction box with a cover to be mounted on the wall nearest to the device the POPIT Module is associated with. All boxes shall be labeled with the appropriate corresponding point contained within.
- N. Integrate the security system to the remote monitoring station. Provide all hardware and cabling as required. Coordinate with Owner for approved remote monitoring service.
- O. All POPIT modules on project shall be mounted above ceiling, easily accessible with a 6' or 8' ladder.
- P. Install two (2) keypads at each athletic field press box: one at maintenance and one to press

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box/concessions. All doors and openings to have door contacts.

- Q. All keypads, sirens and POPEX modules shall have dedicated homeruns from each device to the master control panel. Do not daisy chain keypads or sirens. Chaining of modules is permitted if location serves multiple areas of coverage.
- R. All POPIT modules and power supplies are required to be located on as-built drawings delivered to owner at substantial completion of project.
- S. Contractor shall install communication wire from freezer/cooler control panels to burglar alarm via POPIT module interface to notify panel should freezer/cooler encounter high temperature condition. Coordinate programming and final terminations with Owner.
- T. All POPEX modules and power supplies shall be installed in IDF closets for that area of coverage with easy accessibility and a dedicated SDI2 homerun to the master control panel not to exceed 500ft.
- U. All device power runs shall be fused and clearly labeled in plain English at each main power source.
- V. All Eyewash stations shall have a dedicated POPIT module per device on the project.
- W. Any generator on site must be monitored through a normally closed, dry contact connection to a dedicated POPIT module and tested to confirm its function for main building AC Loss.

### 3.2 CABLE PATHWAYS

- A. Cable Support:
  - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
    - a. Approved Cable Support Manufacturer:  
Panduit Corporation  
Erico/Caddy  
B-Line  
Supports shall be sized appropriately for the number of wires being supported. Reference the manufacturer's specifications for the suggested maximum cables per support size.
  - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the cable support hook to the treaded rod.
  - 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
  - 4. All cable installed shall be attached to the cable support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support, to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
  - 5. ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.
  - 6. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.
- B. Conduit / Raceway:
  - 1. All wire shall be installed in an approved conduit/raceway system (except where

permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

### **3.3 SYSTEM OPERATION**

- A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:
  1. The system keypad's interior audible device shall sound until silenced by using proper security code or after system time out.
  2. A custom system alarm message shall be displayed on the LCD display. This display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.
  3. The remote signaling tie connection shall be activated at the Owner's approved central security monitoring location and/or other Owner designated location.
  4. Printer shall provide printed copy of events recorded in logger. Install adjacent to security panel.

### **3.4 SYSTEM ZONING AND PARTITIONING**

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.
- B. All zoning/device locations shall be field programmable.
- C. Input control zones shall be coordinated with the owner prior to final programming.

### **3.5 TESTING**

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

### **3.6 WARRANTY**

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.
- B. An Extended Manufacturer's Warranty will be provided to the Owner if the Sub-Contractor entitled to the job has an agreement for an extended warranty already in place with the Manufacturer.

### **3.7 SOFTWARE**

- A. Provide two electronic copies of the final programming and program software to the Owner's Police Technology Foreman after final approval.

**END OF SECTION**

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## SECTION 28 23 00 – IP SECURITY CAMERA SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### PART 1- GENERAL

#### 1.1 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes
- D. 27 10 00 – Structured Cabling System
- E. 28 05 00 – General Electronic Safety Systems Requirements
- F. 28 13 00 – Access Control System
- G. 28 16 00 – Intrusion Detection System

#### 1.2 DESCRIPTION OF WORK

- A. Provide a complete and tested IP based digital video surveillance system including cameras, cabling, digital image storage, integration and accessibility with Owner's Local/Wide Area Network (LAN/WAN), Internet accessibility through remote view application software and simultaneous user access capability. Provide fully terminated unshielded twisted pair (UTP) cable, UTP terminations, racks, raceways, conduit, and other incidental and miscellaneous premises wiring system hardware as required for a complete and useable system. The installation shall comply with applicable codes and standards in effect at the job site and as indicated in the Specifications and Drawings.
- B. The system shall be Non-Proprietary in nature and be available through multiple distribution channels in the nearest metropolitan marketplace. Systems that are manufactured and installed by a factory office and are not available through multiple distribution channels will not be accepted.
- C. Provide all electronic hardware and coordinate with the building's LAN/WAN. The contractor shall coordinate with other system vendors, where appropriate, to facilitate equipment installation, scheduling, protection of equipment and access to the project site in order to provide the Owner a substantially complete project in a timely manner.
- D. Acceptable manufacturers of NVR equipment shall be **GCON or BCD Video only**. Contractor must be a current **Exacq** Enterprise Certified integrator of the solution in the Houston marketplace and be able to include information on current support staff to be able to service this client. GPON or BCD Video NVR part numbers and configuration are listed in the specification to define equipment capabilities and requirements for this project.
- E. Contractor must be a current integrator of solution in the Houston marketplace and be able to include information on current support staff to be able to service this client as needed 24x7 for emergency support.
- F. Contractor shall provide a complete turnkey solution to the owner and be responsible for the complete installation of a fully functional security camera system.
- G. The contractor must be in good standing with the district and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the contractors bid.

### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
1. The Video Surveillance System Installer shall be Exacq Enterprise certified and shall meet all applicable regulations. The Contractor shall be a firm normally employed in the security and surveillance industry.
  2. The contractor shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein. Each contractor shall furnish with their submittal a letter from the manufacturer indicating they are a dealer in good standing.
  3. The contractor must be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels.
  4. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of video surveillance distribution systems and have personnel who are adequately trained in the use of such tools and equipment.
  5. A resume of qualifications shall be submitted with the Contractor's proposal indicating the following:
    - a. A list of five recently completed projects using the product proposed of similar type and size with contact names and telephone numbers for each.
    - b. A list of test equipment proposed for use in verifying the installed integrity of metallic cable systems on this project.
    - c. A technical resume of experience for the contractor's Project Manager and on-site installation supervisor who shall be assigned to this project.
    - d. A list of technical product training attended by the contractor's personnel that shall install the video surveillance system shall be submitted.
    - e. Any subcontractor who shall assist the video surveillance contractor in performance of this work shall have the same training and certification as the video surveillance contractor.
- B. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

### 1.4 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Local Building Code
  2. Local Electrical Code
  3. NEC National Electrical Code
- B. Other references:
1. TIA/EIA-568-A - Commercial Building Telecommunications Wiring Standard
  2. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
  3. TIA/EIA-606 - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

4. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
  5. TIA/EIA TSB 67 - Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
  6. ISO/IEC 11801 - Generic Cabling Standard
  7. EN 50173 - Generic Cabling Standards for Customer Premises
- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes, regulations, and manufacturer installation requirements, then the requirements of these specifications and the drawings shall govern. However, nothing in the drawings or specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

## 1.5 SUBMITTALS

- A. The video surveillance system installer shall furnish all CCTV system submittals in a single consolidated submittal.
1. Specification Compliance: A letter shall be provided stating, by section and subsection, that the installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE DISTRICT'S LIFE SAFETY SYSTEMS DIVISION STAFF.
- B. Shop Drawings: Submit the following items, for Owner review and approval:
1. Samples: Complete manufacturer's product literature and samples (if requested) for all pre-approved substitutions to the recommended products made during the course of the Project.
  2. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer
  3. Product Literature: Complete manufacturer's product literature for all electronics, cable, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Architect/Engineer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
  4. Testing: Proposed Contractor test result forms, a list of instrumentation to be used for systems testing.
- A complete point-to-point floor plan diagram indicating camera locations and all required cabling to connect systems.
- C. Project Completion: As a condition for project acceptance, the Contractor shall submit the following for review and approval:
1. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
  2. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)

3. All training sessions with district staff and training media shall be complete.
4. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2017 or later. Provide the Owner with electronic versions of the as-builts on CDs.

## **PART 2 – PRODUCTS**

### **2.1 SUBMITTALS**

- A. The data cabling to each camera location on this project shall be provided and installed by the security camera data cabling contractor. The security camera installing contractor shall be responsible for the installation of all power wiring for exterior PTZ domes and power supplies.
- B. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- D. Materials shall be as listed no alternate products will be allowed without prior consent of the project's security consultant. Any items approved as equivalent products shall be published by addendum ten days prior to proposal for Architect/Engineer review.
- D. All equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.
- E. All systems and components shall have been thoroughly tested and proven in actual use.
- F. All systems and components shall be provided with the availability of a toll free 24-hour technical support phone number from the manufacturer. The phone number shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge.
- G. All systems and components shall be provided with an explicit manufacturer warranty.

### **2.2 DATA CLOSET (MDF/IDF) TERMINATION HARDWARE**

- A. Provide and Install new Tripplite, #B030-008-17-IP, NetDirector 8-Port 1U Rack-Mount Console HDMI KVM Switch with 17 in. LCD and IP Remote Access, Dual Rail.
- B. Security contractor is responsible to coordinate with District Life Safety Systems Department on acquiring network connections as well as any network configuration information such as IP numbers that will be required to connect NVR servers to district network.
- C. Security contractor is responsible to provide network cabling connection, either fiber or category 6A, to owner provided network equipment. This connection allows NVR to be connected to owner's local area network.
- D. Security contractor shall provide (1) Minuteman E2000RTXL2U UPS per NVR unit at each rack location to support NVR equipment. Provide 120v. electrical connection at location where NVR is installed.

### **2.3 CABLE AND INSTALLATION**

- A. The Contractor shall provide and install all low voltage plenum rated power cable to exterior PTZ dome camera locations from a central power supply(s). Each power cable shall be individually fused at the power supply so a short in one power cable will blow that fuse and not affect the other cameras. The power supply will be UL listed in an approved enclosure. It is the responsibility of the Contractor to size the power supply to handle the full load of the cameras.
- B. The data cabling to each camera location on this project will be provided and installed by cabling contractor certified by Systimax and authorized to install the cable plant and connectivity products. All category 6 cable shall be Systimax Purple 2071 CAT6.
- C. Camera contractor is responsible to request and oversee all penetrations and all conduit runs as necessary for installation of CCTV installation.
- D. All exterior penetrations require necessary weatherproofing to avoid moisture penetration.
- E. All Cameras will require 10ft purple Cat6 patch cord at camera location and 1ft purple CAT6 patch cord at panel location.
- F. All outdoor cable runs underground shall be in fiber rated for underground use according to Technology specs.
- G. All power circuits required for the NVR servers are to originate as emergency power from its provided UPS.
- H. Contractor shall not run any power cabling for any security equipment on rack tray system due to EMI considerations. Contractor shall provide individual cabling support for all low voltage power cabling.
- I. All cabling for entire project shall be installed at 5'-0" intervals in dedicated support system using a j-hooks support system. Cable supports will be securely attached directly to building structure. Do not attach cabling or supports to ductwork, piping, grid hangers, conduit, or equipment.
- J. Refer to CFISD structured cabling specifications for Category 6 materials and methods.
- K. All Category 6 cabling shall be routed to existing MDF and IDF locations and be terminated on existing racks. Provide additional patch panels as required and label ports using existing labeling scheme.
- L. For all cameras that will exceed the maximum Category 6 cable limitation the contractor shall provide and install Veracity Outreach Max universal Ethernet and Poe Extender and clearly identify on as-builts. If installed a spare unit will be provided to the owner.

## **2.4 PROPOSALS**

- A. All proposals shall be in the format as shown in the General Conditions Section of the Specification.

## **2.5 DIGITAL VIDEO RECORDING, MANAGEMENT AND TRANSMISSION SYSTEM**

- A. The contractor shall provide and install Network Video Recorders for this project.
- B. Final connection for all new IP cameras shall be provided by the camera contractor. Coordinate all recording settings and functions with owner prior to programming.

- C. Network Video Recorders shall be preprogrammed to include a floor plan graphic of each school and the exact camera locations and name of cameras. Field verification of camera names is required to complete this task.

## 2.6 EQUIPMENT REQUIRED

- A. Provide a 5 year warranty for all NVR equipment.
- B. Digital Video Recorders
  - 1. Provide One GCON, DC54-C160T-2167S, or BCD video, BCD208X-410Y-160T-20-2A4K-CFISD-BU, server per 75 cameras to be installed unless stated otherwise.
  - 2. The contractor shall coordinate correct Exacq software version prior to submitting or procuring equipment.
  - 3. NVR must have SSA agreement in place for two years at time of install.
  - 4. In response to proposal, contractor shall provide owner with amounts of annual service maintenance agreement than can be purchased after warranty ends.

## 2.7 CAMERAS

- A. Camera Types:
  - 1. All ceiling mounted cameras shall be surface mounted and accessible by 10 ft ladder.
  - 2. All cameras shown on the drawings to be corner mounted shall receive corner mount kit by specified camera manufacturer, no exception.
  - 3. Where cameras have been discontinued, provide manufacturer's recommended replacement. Confirm with security consultant prior to purchase.
    - Type 1** Interior Fixed cameras shall be Bosch NDV-5703-AL or Axis P3265LV if primary is not available.
    - Type 2** Exterior Fixed cameras shall be Bosch NDE-5703-AL or Axis P3265-LVE if primary is not available.
    - Type 3** Interior Panoramic cameras shall be Bosch NDS-5703-F360LE.
    - Type 4** Multi-sensor Interior/Exterior cameras shall be Wisenet PNM-C16083RVQ or Axis P3727-PE if primary is unavailable.
      - a. Provide Corner Mounts for Exterior Cameras.
    - Type 5** Duo cameras shall be Axis 4707-PVLE Platform with IR or Wisenet PNM-7082RVD if Axis is unavailable.
    - Type 6** Axis F9114 and Axis F4105-LRE sensors shall be provided to view around a column or skylight where a center mounted single camera cannot be employed. All F4105-LRE lens must be installed with Axis TU6005 Plenum Cable accessory.
    - Type 7** Specialty PTZ camera will be Axis Q6318-LE PTZ if specifically called for by owner.
- B. Field of View Determination by the contractor as necessary for fixed camera locations shall be performed at no additional cost to provide the view desired by the owner. Contractor shall coordinate all final camera views and locations with owner for final approval.
- C. IP camera address scheme will be provided to contractor by the owner. All Camera addresses shall follow the provided scheme and be sequential.

- D. Refer to Drawings for additional camera part numbers and Quantities.
- E. Confirmation of camera type per location requires customer verification.

**2.8 ADDITIONAL HARDWARE OR EQUIPMENT REQUIRED**

- A. Licensing to be provided for all equipment that require licenses.
- B. Camera mounts and brackets shall be per camera manufacturer.
- C. One ViewSonic VX3211-4K-MHD 32" LED Monitor is required per NVR.
- D. One of each type of camera used on the project is required upon final inspection for spare replacement equipment.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Provide three-sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.
- C. Install new conduit on portable pipe supports- (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.
- D. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom)
- E. Wall Penetrations:
  - 1. Exterior Penetrations – shall be performed by a certified electrical contractor and be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
  - 2. Interior Penetrations – shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
- F. Cable Pathway:
  - 1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 25 cables or less, with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks attached to the existing building structure and framework at a maximum of five (5) foot intervals. Plenum rated cable ties shall be used in all appropriate areas. The Contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all cables.
  - 2. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
  - 3. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.

### **3.2 EQUIPMENT RACK CONFIGURATION**

- A. Cable Placement: Cable installation in the wiring closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.
- B. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.
- C. Cable shall be routed as closely as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

### **3.3 WIRING INSTALLATION**

- A. General:
  - 1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.
  - 2. All cable must be handled with care during installation so as not to change performance specifications.
- B. Exposed Cable: All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cable shall only be run where indicated on the Drawings. Additional exposed cable runs shall require Owner approval, and shall only be allowed when no other options exist. Cabling shall be installed concealed at all times, except in unfinished mechanical rooms or wiring closets where cable shall be installed exposed and located to avoid conflicts with pass-through cabling, etc. Tie wraps shall be used to provide a neat appearance. Provide "D" rings or the appropriate cable guides to dress the cable.
- C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.
- D. Cable Routes: All cabling placed in ceiling areas must be in conduit, cable tray, or J-Hooks. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Attaching cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Caddy CAT 21 or CAT 32 hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable rings on 36" maximum centers to hang cable. Cable shall be routed so as to provide a minimum of 18" spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple cables to be banded together every 6 feet.

### **3.4 DOCUMENTATION**

- A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on



corresponding camera locations. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.

- B. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. Labeling system shall correspond to the Owner's labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.
- C. All cables shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.
- G. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

### **3.5 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS**

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and time table for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.
- H. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

### **3.6 INSPECTION**

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

### **3.7 WARRANTY**

- A. Labor and all other costs as necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion.
- B. Guarantee and warrant all equipment provided for a period of 3 years following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration. All such warranties shall include all parts (NVR's, and Cameras).

**END OF SECTION**

## **SECTION 28 31 00 – FIRE SAFETY SYSTEM**

### **PART 1 – GENERAL REQUIREMENTS**

#### **1.1 SCOPE**

- A. The contractor shall furnish and install a complete distributed microprocessor based 24VDC, electrically supervised, MULTIPLEX, integrated fire alarm and voice evacuation system as specified herein and indicated on the drawings. The system shall include, but not be limited to, all control equipment, remote transponders, printer, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.
- C. The system shall be wired as a Class B supervised system for all circuits.
- D. Synchronize all strobes on project.
- E. Provide two communications paths: digital cellular and IP Internet communicator over CFISD data network.
- F. Ensure fire alarm system monitors all other fire detection systems; all fire suppression systems including fire sprinkler, and dry agent suppression systems and spray paint booths.
- G. The fire alarm specifications included are to provide a base line criteria for the project. The contractor shall provide a complete engineered system which meets or exceeds all current codes.
- H. Provide wiring and to support 8 portable buildings (16 classrooms; 40 initiating devices, 2 dedicated NAC circuits). Wiring and transponder panel shall be located, and wiring shall be terminated to a point as designated by CFISD. Verify project exact requirements with CFISD.

#### **1.2 CODES AND STANDARDS**

- A. The system shall comply with the applicable Codes and Standards as follows:
  - 1. National Electrical Code - Article 760.
  - 2. National Fire Protection Association Standards:
    - NFPA 70 NEC
    - NFPA 72 National Fire Alarm Code (2013)
    - NFPA 90A Air Conditioning
    - NFPA 101 Life Safety Code
    - UL 1971 Visual Devices
    - ANSI 117.1 Visual Devices
  - 3. Local & State Building Codes (Including all adopted amendments)
  - 4. Texas Accessibility Standards (TAS)
  - 5. American's with Disabilities Act (ADA)
  - 6. Requirements of Local Authorities having Jurisdiction
  - 7. Underwriters Laboratory Requirements and Listings for use in Fire Protective Signaling Systems as follows:
    - UL 864 Control Panels (9<sup>th</sup> Edition)
    - UL 268 Smoke Detectors - Systems
    - UL 268A Duct Smoke Detectors
    - UL 521 Heat Detectors

UL 228 Door Holder-Closers  
UL 464 Audible Signaling Appliances  
UL 1971 Visual Signaling Appliances  
UL 38 Manual Alarm Stations

### 1.3 ACCEPTABLE MANUFACTURERS

- A. To establish the type, quality, and features of system required, the equipment specified is that of the NOTIFIER Fire Systems.
- B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.
- C. All references to manufacturer's or supplier's model numbers and other pertinent information herein is intended to establish a minimum standard of quality, performance and features required. All equipment proposed as an EQUAL to that specified shall COMPLETELY conform to the specifications herein.
- D. Equipment of other manufacturer's or supplier's may be considered as an equal to that specified provided that completely marked and identified catalog sheets of all proposed equipment is provided to the architect/ engineer for review ten (10) days prior to the date of bid for evaluation. In addition, a list of the contractor's qualifications and any exceptions to the specifications must be provided for review. Approval for any such substitution of equipment must be obtained in writing from the architect/engineer five (5) days prior to bid.
- H. All equipment provided shall be available for purchase from at least two authorized distributors within the greater Houston metropolitan area. Single source proprietary equipment is prohibited unless approved by CFISD.
- E. Provide the following manufacturers:
  - 1. Notifier INSPIRE series or its successor.
  - 2. Siemens Cerberus PRO Modular

### 1.4 GENERAL REQUIREMENTS

- A. Contractor Qualifications:
  - 1. The equipment supplier shall be an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment.
  - 2. The equipment supplier and installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
  - 3. The installing contractor and/or equipment supplier shall have on his staff a minimum of three (3) installation technicians who are licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
  - 4. The installing contractor or equipment supplier shall have on staff a minimum of one (2) certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.
  - 5. The installing contractor shall provide 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.
  - 6. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) years.

## 1.5 SUBMITTALS

- A. The installing contractor and/or equipment manufacturer shall provide complete and detailed shop drawings and include:
  - 1. Control panel configuration including wiring and interconnection schematics.
  - 2. Complete point to point wiring diagram showing terminal connections to all system devices.
  - 3. Riser wiring diagram and associated zoning/addressing configurations with associated conduit sizes.
  - 4. Complete floor plan drawings locating all devices associated with the fire alarm system. Floor plan drawings shall include conduit and wiring routing complete with conduit sizing and number of conductors by type. Floor plans shall be on AutoCAD 2013 or later.
  - 5. Factory data sheets on each piece of equipment to be used and so marked as to model, dimensions, size, voltage, and configuration.
  - 6. Detailed system description in this specification format describing system functions and operation. All specification variations and deviations shall be clearly noted and marked.
  - 7. Complete Bill of Material for reference.
  - 8. Programming matrix defining all input/output functions and zoning.
  - 9. Power supply and battery calculations.
  - 10. Written certification from the manufacturer stating that the distributor is authorized to sell, service and install the proposed fire alarm system.
- B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.
- C. Written performance specifications, in lieu of detailed fire alarm drawings and plans, shall be provided by the MEP Engineer as directed by the Texas Board of Professional Engineers (TSBPE) as part of the project contract documents. The detailed planning and design of the fire alarm system shall be provided by the fire alarm contractor's planning superintendent or their professional engineer and as required by the State Fire Marshal and the TSBPE. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor's responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

## 1.6 ADDITIONS AND RENOVATIONS

- A. Design Development: Architect and Engineer shall verify with the local AHJ and local building codes as to the extent of existing fire alarm system upgrades or possible partial or full replacement of the fire alarm system due to the amount and scope of the planned renovation. This verification with the AHJ shall also include determining if a distributed antenna system (DAS) for fire department radio communications will be required inside the building. If required, the DAS shall be included in the project specifications as a separate specification, and not part of the fire alarm system specification. The A/E team shall then verify with CFISD the extent of such upgrades to be included in the project construction documents.
- B. Ensure existing building fire alarm system is protect from damage during renovations and additions.
- C. Maintain existing fire alarm system in full working condition in existing building during building addition projects or provide a fire watch acceptable to the local AHJ and CFISD.
- D. Bag or cover all alarm initiating devices during renovations in areas that are under construction. Remove covers at the end of each day.

- E. Maintain access to all existing equipment.
- F. Prior to construction, a system test shall be required of the constructor to demonstrate the current state of the system. Any non-functioning item at this time shall be noted by the contractor and addressed by CFISD maintenance. Either the deficiency will be corrected by CFISD maintenance, or the remedy shall be included in the contract documents to be repaired or corrected by the contractor unless otherwise directed by CFISD. A written report of the outcome of the initial test shall be submitted by the contractor to the Architect and reviewed CFISD. If system is proven to be 100% functional, or the contractor fails to submit the report in a timely manner for CFISD review prior to construction, the contractor is responsible for any repair necessary to return it to a fully operational system acceptable to the AHJ and CFISD at no additional cost to CFISD.
- G. When the fire alarm system is fully tested and 100-percent fully operational, a demonstration is required by the contractor to demonstrate to the Architect and CFISD that the system is fully operational as requirement for project substantial completion. This demonstration for CFISD is not intended for contractor's testing and commissioning of the system, it is for demonstration of a fully operational system. If excessive failures or deficiencies occur, the Architect may cancel the demonstration and reschedule at a time convenient to CFISD.

## 1.7 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of: electrical contractor, sprinkler contractor, and HVAC/controls contractor and intercom system. Adequate coordination shall be provided to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.

## PART 2 - PRODUCTS

### 2.1 SYSTEM FUNCTIONAL OPERATION

#### A. ALARM DETECTION

- 1. When a fire alarm condition is detected via the main fire control panel by any of the system alarm initiating devices, the following functions shall occur:
  - a. Signal the Fire Alarm Control Panel. Identify the addressable point at the Fire Alarm Control Panel and the remote fire alarm annunciator.
  - b. Sound a distinctive voice evacuation signal followed by a tone signal throughout the entire building and all other buildings served by the fire alarm system and all buildings sharing the same 911 physical building address.
  - c. Simultaneously activate all visual fire alarms.
  - d. Shut down all mechanical equipment rated 2000 cfm or greater other than smoke removal exhaust fans. This equipment shall include, but shall not be limited to, air handling units, ventilation fans, fan powered boxes, and side pocket boxes. Signal other devices required for passive or active smoke control. Close all smoke control dampers. Provide control relay within three (3) feet of each damper or power supply for motor drives or fail-safe dampers. When fail-safe smoke dampers are powered in parallel from a common power circuit then fire alarm relay may be provided to interrupt common power circuit; separate relay not necessary at every such damper. Install supervised fire alarm wiring from relay to fire alarm control panel. Resetting fire alarm system shall include opening smoke control dampers and resetting of all other control devices to normal operation.
  - e. Activate the automatic digital cellular telephone dialer, IP communicator, and alarm

- contact closure for use with approved central station monitoring service.
- f. Release all fire and smoke control doors on hold-open devices so that doors may close. Raise or open all security grilles for first responder building access. Operation of any culinary or kitchen hood fire suppression system shall initiate an alarm condition on the building fire alarm control panel. Building fire alarm system shall initiate an alarm over all notification appliance circuits as required by NFPA 72. Comply with NFPA 96 Standard for Commercial Cooking Operations. Actuation of a wet or dry chemical shall cause building fire alarm per NFPA 17.
  - g. Sprinkler System: Operation of any sprinkler system water flow switch shall activate the sprinkler alarm bell and initiate an alarm condition at the fire alarm panel.
  - h. All audio and visual alarm signals shall continue until the alarm acknowledged switch is depressed. Once the alarm acknowledge switch is depressed, the audio and visual alarm signals shall then stop, but the annunciator shall remain lighted until the system is reset.
  - i. Acknowledging of any alarm signal shall not interfere with the re-activation of the alarm signals upon an alarm from another zone.
2. Elevator lobbies shall be provided with one smoke detector. Upon activation of the lobby smoke detector, all elevators shall be automatically recalled to the ground floor. In the event of a fire on the ground floor, all elevators shall be automatically recalled to the 1st terminus floor above the ground floor served by the respective elevator bank.
  3. Activation of the heat detector at the top of each elevator shaft and elevator machine room shall activate a shunt trip.
  4. All designated "non-silenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).
  5. In addition, remote annunciators shall be located where indicated. The annunciators shall duplicate the control panel alarm status indicators (for selected system zones/points) and in addition, announce any system trouble conditions and operate as herein specified.

## B. ALARM VERIFICATION

Alarm verification shall be field programmable for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified. The system shall incorporate the ability to log in memory, the number of verification events that have occurred for each selected device.

## C. SYSTEM TROUBLE DETECTION

1. When a trouble condition is detected by the CPU, one of the system initiating alarm or SLC circuits, the following functions shall immediately occur:
  - a. The system trouble LED on the CPU module shall flash, and the internal audible trouble device shall sound. Acknowledgment of the trouble condition shall silence the audible trouble device and cause all trouble LED's to illuminate steady.
  - b. The alphanumeric LCD annunciator shall display all applicable information associated with the respective trouble condition and its location.
  - c. The system common trouble indicator on associated remote annunciators shall be illuminated as specified herein.

## 2.2 ZONING

- A. The system shall employ addressable, intelligent, dedicated or multi-criteria smoke and/or heat

detectors capable of being recognized and annunciated at the main control panel on an individual basis. All zoning/device location information shall be totally field programmable to exact job requirements as approved by the fire alarm planner and architect/engineer.

- B. The system shall utilize remote transponder panels for distributed voice communications, and auxiliary control output circuits. Remote transponder panels shall communicate with the main CPU via the SLC data loop and be capable of being intermixed on the same loop as intelligent smoke detection and control modules. All remote transponder and panels shall be supervised.

### 2.3 QUALITY ASSURANCE

- A. A pre-building construction meeting, followed with a pre-fire alarm system installation meeting shall be schedule with the Architect, Engineer, and Owner after AHJ approval of contractor's fire alarm plan layout and Architect/Engineer/CFISD review of contractor's shop drawings.

### 2.4 WARRANTY

- A. One year from Substantial Completion.

### 2.5 DEMONSTRATION AND TRAINING

- A. Furnish four hours of instruction each for two persons, to be conducted at project site with manufacturer's representative. A written test report from an authorized representative that the system has been 100% tested and functioning prior to training and demonstration. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities have jurisdiction and CFISD personnel.
- B. The contractor shall be responsible for making any changes, adjustments, or corrections as may be required by the local authorities.

### 2.6 FIRE ALARM CONTROL PANEL

- A. Main fire alarm control panel (FACP) CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, annunciators, and other system-controlled devices.
- B. FACP Shall be installed in building MDF.
  - 1. Operator Control
    - a. Acknowledge Switch
    - b. Alarm Silence Switch
    - c. Alarm Activate (Drill) Switch
    - d. System Reset Switch
    - e. Lamp Test
  - 2. System Capacity and General Operation
    - a. The control panel or each network node shall provide or be capable of expansion to 636 intelligent/addressable devices.
    - b. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
    - c. The control panel or each network node shall support up to 8 additional output modules (signal, speaker, telephone, or relay), each with 8 circuits for an additional 64 circuits. These circuits shall be either Class A (Style) or Class B (Style Y) per the project drawings or specifications.

- d. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color-coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
- e. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
- f. The system shall allow the programming of any input to activate any output or group of outputs.
- g. The FACP shall support logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming.
- h. The FACP or each network node shall provide the following features:
  - i. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
  - ii. Detector sensitivity test, meeting requirements of NFPA 72. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
  - iii. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03 percent per foot to 1.0 percent per foot. The system shall also include up to nine levels of Pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.
  - iv. The ability to display or print system reports.
  - v. Alarm verification, with counters to alert maintenance personnel when a detector enters verification 20 times.
  - vi. PAS pre-signal, meeting NFPA 72 requirements.
  - vii. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
  - viii. Periodic detector test, conducted automatically by the software.
  - ix. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
  - x. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
  - xi. Walk test, with a check for two detectors set to same address.
  - xii. Control-by-time for non-fire operations, with holiday schedules.
  - xiii. Day/night automatic adjustment of detector sensitivity.
  - xiv. Device blink control for sleeping areas.
  - xv. The FACP shall be capable of coding main panel node notification circuits.
  - xvi. Network Communication -The network architecture shall be based on a Local Area Network (LAN).

C. System Display

- 1. The system shall support the following display mode options:
- 2. The display shall include a minimum 80-character backlit alphanumeric Liquid Crystal Display (LCD) or comprehensive LCD wide format display or graphic user interface (GUI).
- 3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
- 4. The display shall also provide Light-Emitting Diodes.
  - a. The display shall provide minimum 8 Light-Emitting Diodes (LEDs) that indicate the



status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.

5. The display shall also provide keypad functions.
  - a. The display keypad shall be an easy to use QWERTY type keypad, similar to a lap-top PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

## 2.7 FIELD DEVICES

### A. Multi Criteria Smoke and Heat Detector (FAPT-851):

1. Notifier Model FAPT-851 intelligent multi criteria acclimating detector shall be provided where shown on the drawings. The intelligent multi criteria Acclimate Plus detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
4. The detectors shall provide address-setting means on the detector heat using rotary decimal switches. No binary coding shall be required. Systems requiring separate detector programming apparatus will be unacceptable.
5. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.

### B. Intelligent Duct Detector

Notifier model DNR series duct mounted "intelligent" photoelectric smoke detectors shall be provided where shown on the drawings. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type "intelligent" photoelectric smoke sensors. The unit shall be capable of interchanging/accepting either photo-electronic or ionization type sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.

The unit shall consist of a clear molded plastic enclosure with integral conduit knockouts. The unit shall be provided with clear faceplate cover to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination. Detectors shall be installed per NFPA 90A, and be listed with the fire alarm control panel. A remote LED shall be located on the corridor ceiling adjacent to the respective detector where detectors are not plainly visible or concealed from view.

C. Intelligent Thermal Detectors

1. Notifier Model FST-851R analog, fixed temperature, thermal detectors shall be provided where indicated on the drawings. The detectors shall use dual electronic thermostats to measure temperature levels in the chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
2. The detectors shall provide address-setting means on the detector heat using rotary decimal switches. No binary coding shall be required. Systems requiring separate detector programming apparatus will be unacceptable.
3. The detectors shall provide dual alarm and power/status LED's. Status LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.
4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.
5. Provide thermal rate of rise detectors where approved by AHJ and allowed by NFPA 72 to reduce false alarms where smoke detection is typically required. Provide fixed temperature (190F) in kitchens and kilns.

D. Addressable Manual Stations

1. Notifier Model NBG-12LX manual stations shall be provided where indicated on the drawings. The manual station shall provide address-setting means using rotary decimal switches. No binary coding shall be required. Provide Stopper II cover.
2. Manual stations shall be designed for semi-flush mounting on standard electrical box. The station shall be constructed of hi-impact red molded Lexan with instructions for station operation in raised white letters. Stations shall be of the dual action type. Each station shall be provided with Stopper II cover.

E. Monitor Module

1. Notifier model FMM-101 addressable monitor modules shall be provided where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices to an intelligent SLC loop.
2. The monitor module shall provide address-setting means using rotary decimal switches. No binary coding shall be required.

F. Control Module

1. Notifier model FCM/FRM control/relay modules or approved equal shall be provided where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The zone may be wired class A or class B - field selected. The control module may be optionally wired as dry contact (form C) relay.
2. The control module shall provide address-setting means using rotary decimal switches. No binary coding shall be required. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steady when the device is actuated via the fire alarm control panel.

H. Remote LCD Alpha-Numeric Annunciators

1. Provide where indicated on the drawings, a Notifier LCD-160 640 character remote LCD

alpha-numeric annunciator or approved equal to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator shall be a backlit eighty-character LCD display and operate via the system RS485 or RS232 serial output terminal from the main FACP. The LCD display shall automatically illuminate upon receipt of an alarm or trouble condition. The illumination source shall extinguish during normal/standby mode to conserve power. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote LCD annunciator shall include:

- a. Integral time-date clock
  - b. Time-date select switch
  - c. Time-date/contrast adjust
  - d. Display/step switch
  - e. System reset
  - f. System silence
  - g. System acknowledge
  - h. Integral trouble buzzer
  - i. Point enable/disable capability
  - j. Full QWERTY keypad for system programming.
2. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The unit shall be equipped with an integral lamp test feature. The unit shall be semi flush mounted where shown.
  3. Provide remote microphone for paging at each remote annunciator.
    - a. Provide (1) two tier CAB-4 cabinet and (1) RM-1 Series Remote Microphone at each Annunciator location. Connect each RM-1 to DVC panel at FACP location.

I. Speakers

Speakers shall be listed under U.L. standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall be System Sensor SP200W Series. Speakers or approved equal shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.

Speakers shall be 4" square or round with textured white decorative grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10 feet. Speakers shall be ceiling mounted as located on the drawings.

J Speakers with Integral StrobeLight

Speakers shall be listed under U.L. standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers/strobe units shall be System Sensor SP2C Series. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points. Speaker/Strobes shall be white. Each speaker/strobe shall be equipped with an integral high intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be designated to be ceiling mounted as indicated on the drawings. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 1971. All strobe lights shall be synchronized.

K. High Intensity Visual Signals

1. High intensity visual alarms shall be xenon strobe type complying with ADA, TAS (Texas

Accessibility Standards), UL 464, UL 1638 and UL 1971, and operate on a 24 VDC limited energy supervised circuit. Signals shall operate in unison with audible alarm appliances. Visual alarm devices may be integral with audible alarm appliances where appropriate.

2. Devices requiring programming onto an SLC circuit shall not be acceptable.
3. Alarm devices shall be flush ceiling mounted in all areas except wall mounted in mechanical, electrical, and technology rooms and when required by NFPA 72 due to excessive ceiling or mounting height. Locate audio devices to ensure adequate voice intelligibility.
4. Provide exterior visual devices only as required by TAS. Provide weatherproof exterior audio alarm devices mounted on the building exterior as required by the AHJ, as directed by CFISD, and at the locations noted below with exact locations as directed by the Architect to coordinate with the building exterior finishes, building elevation aesthetics and voice intelligibility.
  - Main entry.
  - Courtyards and outdoor assembly areas adjacent to the building.
  - Mechanical yards adjacent to the building.
  - Covered playgrounds or covered assembly areas adjacent to the building.
  - Additional locations where indicated on drawings.
  - Outdoor paved play areas.
  - Designated muster locations used for fire drill

High intensity visual alarms shall be Xenon strobe type producing a minimum of 15 candela on a 24 VDC limited energy supervised circuit. Each strobe light shall be capable of providing multi candela output. Alarm devices shall be designated to be wall or ceiling mounted as indicated on the drawings. Signals shall operate in unison with audible alarm appliances. High intensity visual signals shall be of solid state low current design and listed to U.L. Standard 1971. All strobe lights shall be synchronized.

L. Sprinkler Waterflow Switch

Sprinkler waterflow switches shall be installed where indicated on the drawings. Each unit shall contain one set of SPDT alarm contacts. Waterflow switches shall be provided and installed by the fire protection contractor, and connected by the fire alarm contractor.

M. Sprinkler Valve Supervisory Switch

Sprinkler valve supervisory switches shall be installed on each valve as indicated on the drawings. Each unit shall contain one set of SPDT contacts. Sprinkler valve supervisory switches shall be provided, installed, and adjusted by the fire protection contractor, and connected by the fire alarm contractor.

N. Auxiliary AHU Relays

Notifier/Air Products Model MR-101/C relays or approved equal shall be provided for HVAC and AHU control and interface. Relays shall be heavy duty type and rated up to 10 amps at 24 VDC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with SPDT contacts as well as activated LED indicator. All interface relays shall be connected to a supervised notification appliance circuit.

O. Field Charging Power Supplies

Provide Notifier FCPS-24S6 power supplies with battery backup as required. Electrical Contractor

shall provide and install a 120 VAC dedicated circuit to each power supply.

P. Air Sampling Detector

Provide a VESDA LaserPlus Series air sampling detector as indicated on the contract drawings and as required to provide proper coverage based on the pipe calculations.

Each VESDA detector shall be interfaced to the fire alarm system via four separate points (one trouble and three distinct alarm points). Each VESDA detector shall be provided with its own battery backup system as required by NFPA 72. Fire Alarm Contractor shall provide pipe system calculations using the Xtralis Aspire modelling software. All VESDA air sampling pipe shall be supported every five feet.

Q. Printer/Printer Stand

A high impact dot matrix printer shall be provided in the MDF near the main FACP. The printer shall provide hard copy printout of all changes in status of the system and shall time stamp such printouts with the current time of day and date. The printer shall be wide carriage with 80 characters per line and shall use standard pin feed paper. The printer shall communicate with the control panel using a fully SUPERVISED interface complying with Electrical Industries Association standard RS 232c. Printer shall be capable of operating on parallel or serial outputs. Power to the printer shall be 120VAC 60Hz. The printer shall print all status information including status, zone, device/point, and programmed custom ID messages.

Provide a table for the printer.

R. Provide a minimum of (50) initiating points for future portable buildings. Provide (2) dedicated NAC circuits pulled to the exit point above the ceiling. Refer to floor plan for location.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Wiring:

1. All wiring shall be in accordance with NFPA 72 and the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
2. Limited energy FPLP wire shall be installed provided such wire is U.L. Listed to U.L. TEST 910 for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
3. All wiring for SLC signaling circuits shall be of the twisted, low capacitance type to guard against outside RF and EMF interference and induced noise.
4. All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and U.L. requirements.
6. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.
7. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.
8. Minimum wire sizes shall be as follows:
  - Initiating Circuits: 18 AWG
  - Strobe Circuits: 14 AWG
  - Relay Control Circuits: 18 AWG
  - Voice / Speaker Circuits: 16 AWG

B. Open Wiring

1. Systems utilizing open wiring techniques with low smoke plenum cable.
  2. Support wire clear of knock out panels, access panels, and maintenance spaces for equipment. Wire and cable shall be run using wire management techniques supporting cable as close as possible to within one foot of the floor or roof rafters. Wire supports shall be directly fastened to the structure on a maximum of five foot centers. Wire routing shall be parallel and perpendicular to building walls. The wire and cable shall be secured with tie wraps or carrier wire. Sagging in excess of three inches will not be allowed nor will bending of the supporting ring structure.
- C. Conduit/Raceway and 120 VAC Power wiring
1. Conduit and raceway system shall be installed in the mechanical, electrical and telephone rooms and as required by NFPA 70. Electrical Contractor shall provide and install all required dedicated 120 VAC power circuits for the fire alarm system including the main fire alarm panel, remote amplifier panels and remote strobe light power supplies.
- D. All wire shall be plenum rated.
- E. Provide printer and printer stand installed at MDF near main FACP.

### **3.2 TEST AND REPORTS**

- A. A state licensed and factory trained technical representative of the manufacturer shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system. Instruction shall be 4 hours minimum.
- B. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and re-tested.
- C. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.
- D. The installing contractor's fire alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections as may be required by the local authorities.
- E. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA Standard 72, Chapter 7. It is mandatory that the installing contractor shall provide such services and make available these services to the owner upon completion of the project.
- F. When the fire alarm system is fully tested and 100-percent fully operational, a demonstration is required by the contractor to demonstrate to the Architect and CFISD that the system is fully operational as a requirement for project substantial completion. This demonstration for CFISD is not intended for contractor's testing and commissioning of the system, it is for demonstration of a fully operational system. If excessive failures or deficiencies occur, the Architect may cancel the demonstration and reschedule at a time convenient to CFISD.

### 3.3 WARRANTY

- A. The fire alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.
- B. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

### 3.4 FLOOR PLANS

- A. Provide (2) 1/16" = 1'-0" floor plan on each floor showing all devices and zoning. Zoning shall correspond to the zone on the fire alarm control panel and remote annunciator. The floor plans shall be framed with a glass cover and located by the fire alarm control panel and by each remote annunciator. Provide a sample for approval.

### 3.5 SPARE PARTS AND ATTIC STOCK

- A. The fire alarm contractor shall include in his bid the cost to provide additional required parts and devices as indicated:
  - 1. (5) CO Detectors
  - 2. (3) Duct Detectors
  - 3. (5) Smoke Detectors
  - 4. (3) Heat Detectors
  - 5. (3) Multi-Criteria Detectors
  - 6. (5) Control / Relay Modules
  - 7. (5) Monitor Modules
  - 8. (5) Horn / Speaker Strobes
  - 9. (5) Horn / Speakers
  - 10. (5) Strobes
- B. Devices on this schedule not used during construction shall be turned over to the owner at the time of job completion

### 3.6 ALTERNATE

The fire alarm contractor shall provide, as an Alternate, pricing for each manual pull station included in the project and the cost to install all stations after substantial completion.

### 3.7 Field Device Building Map

- A. For High School and Middle School campuses, provide 30 x 42- inch composite drawing for field devices and numbering with Lexan protective covering and framed.
- B. For Elementary School campuses provide 22 x 17-inch composite drawing for field devices and numbering with Lexan protective covering and framed.
- C. Framed drawing shall be installed adjacent to FACP in building MDF and at remote annunciator.

D. FML shall be framed and mounted at FACP.

**END OF SECTION**



## **SECTION 31 00 00 - EARTHWORK**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Operations required for the excavation of materials on site.
  - 1. Operations required for the excavation of borrow material from approved sources.
  - 2. Compaction of natural subgrades.
  - 3. Placement and compaction of embankments to grade.
  - 4. Finish grading.
  - 5. Disposal of excess or unsuitable materials.
  - 6. Other required operations.
  - 7. Earthwork must conform with dimensions and typical sections shown, and within lines and grades established on the Drawings.
- B. The Contractor shall inform and satisfy himself as to character, quantity and distribution of material to be excavated.

#### **1.2 EXISTING UTILITIES**

- A. The plans show the approximate location of all known underground utility lines and structures. Where pipes, ducts and other structures are encountered in the excavation but are not shown on the plans, immediately notify the Owner's Representative.

#### **1.3 CLASSIFICATIONS**

- A. Top Soil: Top 6 inches of natural surface soil possessing the characteristics of representative soils on the site that produce growths of grass or other vegetation. Topsoil includes grasses and other vegetation.
- B. Subgrade: Consists of that portion of the surface on which a compacted embankment or pavement is constructed.
- C. Compacted Embankment: Earth fill placed and compacted between subgrade and underside of pavement and fill areas adjacent to paving.
- D. Borrow: Material taken from approved sources to make up any deficit of excavated material. The borrow shall have a measured plasticity index of between 7 and 20, and shall be free of organic matter and excess silt.
- E. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.
- F. Stripping of Ground Surface: All vegetation, all decayed vegetable matter, rubbish and other unsuitable material within the areas to be graded not removed by clearing shall be stripped or otherwise removed to ground level before grading or other earthwork is started. In no case will such material be allowed to remain in or on the areas to be graded.
- G. Excavation: After all necessary stripping has been done, excavation of every description and of whatever substances encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings.

- H. Compaction: Compaction of soil materials shall be measured as a percentage of Standard Proctor density as determined by the AASHTO Standard T 99 procedure.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT**

- A. Furnish, operate and maintain such equipment as is necessary to produce uniform layers, section and smoothness of grade for compaction and drainage.
- B. Tamping Rollers:
  - 1. Use tamping rollers with one or more cylindrical drums. Each cylinder must be at least 48 inches long and 40 inches in diameter.
  - 2. The minimum weight per linear foot of drum length must be 1500 pounds weighted and 1000 pounds empty.
  - 3. For tamping rollers with multiple cylinders, each cylinder must rotate independently and the cylinders must be pivoted on the main frame so that the units can adapt to irregularities in the ground surface.
  - 4. Provide approximately 2.7 tamping feet per square foot of drum surface on each cylinder. Stagger the feet uniformly over the cylinder surface. Each foot should have a face area between 5 and 7 square inches and a clear projection from the cylinder surface of 7 to 9 inches. Equip each unit with a device for cleaning the feet as the cylinders rotate.
  - 5. Use a crawler tractor with sufficient power to pull the tamping roller at a speed of approximately 3.0 miles per hour.
- C. Rubber Tire Rollers:
  - 1. Use rubber tire rollers having two axles and not less than a total of nine wheels with pneumatic tires.
  - 2. Mount the wheels so that the rear tires will not follow in the tracks of the forward tires and so the unit will give uniform compaction over the entire width of coverage.
  - 3. Mount the axles in a rigid frame with a loading platform or body suitable for being ballasted to a specified gross weight between 10 and 50 tons loading. The Owner's Representative will specify the tire inflation and gross weight.
  - 4. If the roller is not self propelled, the towing equipment must also have pneumatic tires.
- D. Use tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.
- E. Scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment and other equipment must be suitable for construction of fills.

### **2.2 EARTH FILL**

- A. Obtain embankment fill from required excavation or, if excavated material is not sufficient, from Borrow areas approved by the Owner's Representative.
- B. Use the best material available from excavation or borrow. Suitability of fill material is subject to the approval of the Owner's Representative.
- C. Fill material must be free of excessive silts. Do not use soil containing brush, roots, sod or similar perishable material.

- D. Embankment material must have a plasticity index between 7 and 20 inclusive.

### **PART 3 EXECUTION**

#### **3.1 REMOVAL OF TOPSOIL**

- A. Remove topsoil within the limits of the construction areas as shown on the Drawings.
- B. Stockpile the topsoil for future distribution. Protect stockpiled topsoil from other excavated materials.

#### **3.2 EXCAVATION**

- A. As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction of embankments or pavement. Remove materials within the indicated limits and dispose of as directed.
- B. Maintain grades during excavation for complete drainage. When required, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the Work.
- C. If at time of excavation it is not possible to place material in the proper section of permanent construction, stockpile the material in approved areas for later use.
- D. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in top 6 inches of subgrade.
- E. Uniformly dress cut and fill slopes to slope, cross section and alignment, as shown.

#### **3.3 SUBGRADE UNDER PAVEMENTS**

- A. After excavation is made to subgrade lines under proposed pavements, remove and replace soft or undesirable material with select material as specified for embankments. Stabilize and compact the subgrade as stated in the sections on stabilization of pavement subgrade.

#### **3.4 TREATMENT OF NATURAL SUBGRADE UNDER EMBANKMENTS**

- A. After excavation is made to lines under proposed embankments, remove soft or undesirable material to a depth determined by the Owner's Representative. Break down sides or holes or depressions to flatten the slopes.
- B. Fill each depression with the appropriate soil for the materials to be placed on the subgrade. Place the fill in layers moistened and compacted as specified in this section.
- C. After depressions have been filled and immediately before placement of compacted fill in a section of the embankment, thoroughly loosen the foundation material to a depth of 6 inches. Remove roots and debris turned up while loosening the soil.
- D. Compact the surface of the embankment subgrade as specified in the following paragraphs.
- E. Take care to prepare the embankment so that planes of seepage or weakness are not induced. Should the Owner's Representative suspect such a deficiency, the material must be thoroughly broken and recompact before proceeding with construction.

### **3.5 PLACING EMBANKMENT FILL**

- A. Do not place fill on any part of the embankment subgrade until the subgrade preparation has been inspected by the Owner's Representative.
- B. During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the embankment material.
- C. After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction must not exceed 8 inches unless otherwise directed. As soon as possible after placement begins, crown the surface to drain freely and maintain such conditions throughout construction.
- D. If the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.
- E. Stabilize and compact the top 6 inches of embankment fills under pavement sections as specified in the section on stabilization of pavement subgrade.

### **3.6 MOISTURE CONTROL**

- A. Developing the maximum density obtainable with the natural moisture of the embankment material is preferred. However, the moisture content must be 1 to 3 percentage points wet of optimum, as determined by AASHTO Test Method T 99.
- B. If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by discing or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other approved method.

### **3.7 COMPACTION**

- A. Compact each layer of embankment with suitable rollers as necessary to secure at least 95% of the standard Proctor density, within the specified range of the moisture content, according to AASHTO Test Method T 99.

### **3.8 DISTRIBUTION OF TOPSOIL**

- A. Preparation:
  - 1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade. Use a chisel plow with the chisels set 10 inches apart.
  - 2. Shape all areas designated for grading, including cut and fill areas, to receive a minimum of 6 inches of topsoil.
  - 3. In areas that require only blading and dressing, the adequacy of existing topsoil will be determined by the Owner's Representative.
- B. Placement:
  - 1. Do not haul or place wet topsoil. Also prohibited is placement of topsoil on a subgrade that is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading or proposed planting.

2. Distribute topsoil uniformly and spread evenly to an average thickness of 6 inches. Do no compact topsoil. Correct irregularities in the surface to prevent formation of depressions where water could stand.
  3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth and suitable for lawn planting.
- C. Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement. Replace topsoil.

### **3.9 MATERIAL DISPOSAL**

- A. Remove excess excavated material and excess topsoil from the area before substantial completion. Stockpile materials separately in designated areas. Excess soil, topsoil and strippings shall become property of the Contractor and shall be removed from the site.
- B. Dispose of waste material without causing expense or damage to the Owner.

**END OF SECTION 31 00 00**

## **SECTION 31 06 20.15 - CEMENT STABILIZED SAND**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Cement stabilized sand.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No payment will be made for cement stabilized sand under this Section unless specifically noted in bid documents. Include payment for cement stabilized sand in unit price for applicable utility or structure installation section.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- E. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM C 150 - Specification for Portland Cement.
- H. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
- I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.
- J. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- K. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- L. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- M. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.
- N. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

#### 1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.03, Materials Qualifications.

#### 1.5 DESIGN REQUIREMENTS

- A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.
  - 1. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
  - 2. Determine minimum cement content from production data and statistical history. Provide no less than 1.5 sacks of cement per ton of dry sand.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C 150.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Division 2 and the following requirements:
  - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
  - 2. Deleterious materials:
    - a. Clay lumps, ASTM C 142 - less than 0.5 percent.
    - b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
    - c. Organic impurities, ASTM C 40, color no darker than standard color.
  - 3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- C. Water: Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

#### 2.2 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

#### 2.3 MATERIAL QUALIFICATION

- A. Determine target cement content of material as follows:
  - 1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
  - 2. Complete molding of samples within 4 hours after addition of water.
  - 3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
  - 4. Perform cement content tests on each sample.
  - 5. Perform moisture content tests on each sample.
  - 6. Plot average 48-hour strength vs. cement content.

7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
- B. Test raw sand for following properties at point of entry into pug-mill:
1. Gradation
  2. Plasticity index
  3. Organic impurities
  4. Clay lumps and friable particles
  5. Lightweight pieces
  6. Moisture content
  7. Classification
- C. Present data obtained in format similar to that provided in sample data form attached to this Section.
- D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:  $f'c\% \frac{1}{2}$  standard deviation

### **PART 3 EXECUTION**

#### **3.1 PLACING**

- A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is +3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

#### **3.2 FIELD QUALITY CONTROL**

- A. Testing will be performed under provisions of Division 1.
- B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.
- C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.
- D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.
- E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.
- F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.



- G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, the following information:
  - 1. Supplier and plant number
  - 2. Time material was batched
  - 3. Time material was sampled
  - 4. Test age (exact hours)
  - 5. Average 48-hour strength
  - 6. Average 7-day strength
  - 7. Specification section number
  - 8. Indication of compliance / non-compliance
  - 9. Mixture identification 3
  - 10. Truck and ticket numbers
  - 11. The time of molding
  - 12. Moisture content at time of molding
  - 13. Required strength
  - 14. Test method designations
  - 15. Compressive strength data as required by ASTM D 1633
  - 16. Supplier mixture identification
  - 17. Specimen diameter and height, in.
  - 18. Specimen cross-sectional area, sq. in.

### 3.3 ACCEPTANCE

- A. Strength level of material will be considered satisfactory if:
  - 1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
  - 2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.
- B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.
- C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.
- D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
- E. Testing laboratory shall notify Contractor, Owner's Representative, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.
- F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

- G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less than 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

#### **3.4 ADJUSTMENT FOR DEFICIENT STRENGTH**

- A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.
- B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula:  $\text{Credit per Cubic Yard} = \$30.00 \times 2 (100 \text{ psi} - \text{Actual psi}) / 100$
- C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to Owner.

**END OF SECTION 31 06 20.15**

## **SECTION 31 06 20.17 - UTILITY BACKFILL MATERIALS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Material Classifications.
- B. Utility Backfill Materials:
  - 1. Concrete sand
  - 2. Gem sand
  - 3. Pea gravel
  - 4. Crushed stone
  - 5. Crushed concrete
  - 6. Bank run sand
  - 7. Select backfill
  - 8. Random backfill
- C. Material Handling and Quality Control Requirements.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No payment will be made for backfill material unless specifically listed in the bid documents. Include payment in unit price for applicable utility installation.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 DEFINITIONS**

- A. Unsuitable Material:
  - 1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
  - 3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
  - 4. Materials contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material:
  - 1. Materials meeting specification requirements.
  - 2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.
- I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.
- J. Refer to Division 33 for other definitions regarding utility installation by trench construction.

#### 1.4 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregate.
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.
- E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.
- H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

- K. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.
- L. TxDOT Tex-460-A - Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

## 1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit description of source, material classification and product description, production method, and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.
- D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.
- E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

## 1.6 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.
- B. Verification tests of backfill materials may be performed by Owner in accordance with Division 1.

## PART 2 PRODUCTS

### 2.1 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
  - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
    - a. Plasticity index: non-plastic.
    - b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
  - 2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
    - a. Plasticity index: non-plastic to 4.
    - b. Gradations:
      - 1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
      - 2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
      - 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.

3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
  - a. Plasticity index: greater than 7.
  - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
4. Class IVA: Lean clays (CL).
  - a. Plasticity Indexes:
    - 1) Plasticity index: greater than 7, and above A line.
    - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
  - b. Liquid limit: less than 50.
  - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
  - d. Inorganic.
5. Class IVB: Fat clays (CH)
  - a. Plasticity index: above A line.
  - b. Liquid limit: 50 or greater.
  - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
  - d. Inorganic.
6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

## 2.2 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Division 31.
- B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
  1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
  2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
  3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Owner's Representative, provided that physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:
  1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
  2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.
- E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

- F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	95 to 100
No. 4	60 to 80
No. 8	15 to 40

- G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner's Representative.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes		
	>15"	15" – 8"	< 8"
1"	95 – 100	100	--
¾"	60 – 90	90 – 100	100
½"	25 – 60	--	90 – 100
3/8"	--	20 – 55	40 – 70
No. 4	0 – 5	0 – 10	0 – 15
No. 8	--	0 – 5	0 – 5

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Division 31 to meet plasticity criteria.
- J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Division 31.
- K. Cement Stabilized Sand: Conform to requirements of Division 31.
- L. Concrete Backfill: Conform to Class B concrete as specified in Division 32.
- M. Flexible Base Course Material: Conform to requirements of applicable portions of Division 33.

### 2.3 MATERIAL TESTING

- A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:
  1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
  2. Plasticity of material passing No. 40 sieve.
  3. Los Angeles abrasion wear of material retained on No. 4 sieve.
  4. Clay lumps.
  5. Lightweight pieces.
  6. Organic impurities.
- B. Production Testing. Provide reports to Owner's Representative from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.
- C. Assist Owner's Representative in obtaining material samples for verification testing at source or at production plant.



## **PART 3 EXECUTION**

### **3.1 SOURCES**

- A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.
- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Owner's Representative may obtain samples for verification testing.
- C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner's Representative, expense for sampling and testing required to change to different material will be credited to Owner through change order.
- D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
- E. Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

### **3.2 MATERIAL HANDLING**

- A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
- B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

### **3.3 FIELD QUALITY CONTROL**

- A. Quality Control
  - 1. The Owner's Representative may sample and test backfill at:
    - a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
    - b. On-site stockpiles.
    - c. Materials placed in Work.
  - 2. The Owner's Representative may re-sample material at any stage of work or location if changes in characteristics are apparent.

- B. Production Verification Testing: Owner's testing laboratory will provide verification testing on backfill materials, as directed by Owner's Representative. Samples may be taken at source or at production plant, as applicable.

**END OF SECTION 31 06 20.17**

## **SECTION 31 11 00 - CLEARING AND GRUBBING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.
- E. Fence removal.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for clearing and grubbing is on a per Acre basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REGULATORY REQUIREMENTS**

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

### **PART 2 PRODUCTS - Not Used**

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Verify that existing plant life and features designated to remain are identified and tagged.

#### **3.2 PROTECTION**

- A. Protect following from damage or displacement:
  - 1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
  - 2. Plants other than trees and landscape features designated to remain.
  - 3. Utilities designated to remain.
  - 4. Bench marks, monuments, and existing structures designated to remain.

#### **3.3 CLEARING**

- A. Remove stumps, main root ball, and root system to:
  - 1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.

2. Depth of 24 inches below finished surface of required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from top soil scheduled for reuse.

#### **3.4 REMOVAL**

- A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Division 1.
- B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

**END OF SECTION 31 11 00**

## **SECTION 31 22 00 - GRADING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Removal of topsoil.
- B. Rough grading the site for site structures, building pads, and play fields.
- C. Replacement of topsoil and finish grading for planting.

#### **1.2 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.3 SUBMITTALS**

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

#### **1.4 PROJECT CONDITIONS**

- A. Protect above- and below-grade utilities that remain.
- B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.
- C. Protect bench marks survey, control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Topsoil - Soil Type: Topsoil excavated on-site.
  - 1. Graded.
    - a. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.
    - b. Provide imported topsoil conforming to the requirements of Division 32 as required.
  - 2. Other Fill Materials: Reference relevant sections of Division 32 and the Drawings.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

### **3.2 PREPARATION**

- A. Identify required lines, leveler contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities that remain, from damage.
- D. Notify utility company to remove and relocate utilities.

### **3.3 ROUGH GRADING**

- A. Remove topsoil from areas to be further excavated, re-landscaped, or degraded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Division 31 Specifications for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

### **3.4 SOIL REMOVAL**

- A. Stockpile excavated topsoil on site.
- B. Stockpile excavated subsoil on site.
- C. Stockpiles: Use areas designated on site, pile depth not to exceed 8 feet (2.5 m); protect from erosion.

### **3.5 FINISH GRADING**

- A. Before Finish Grading:
  - 1. Verify building and trench backfilling have been inspected.
  - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove/Break-up soil clumps greater than 1" in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).
- E. Place topsoil in areas where seeding is indicated.

- F. Place topsoil where required to level finish grade.
- G. Place topsoil to the following compacted thicknesses:
  - 1. Areas to be Seeded with Grass: 6 inches (150 mm).
  - 2. Areas to be Sodded: 4 inches (100 mm).
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.

### **3.6 TOLERANCES**

- A. Top Surface of Subgrade: Plus or minus 1/10 foot (30 mm) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 1/2 inch (13 mm).

### **3.7 FIELD QUALITY CONTROL**

- A. See Division 1 and Division 31 for compaction density testing.

### **3.8 CLEANING AND PROTECTION**

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water. Excess topsoil and subsoil to be removed at no additional cost to owner.
- B. Leave site clean and raked, ready to receive landscaping.

**END OF SECTION 31 22 00**

**SECTION 31 23 00**

**EXCAVATION AND BACKFILL FOR STRUCTURES**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Excavation, backfilling, and compaction of backfill for structures.

**1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No payment will be made for structural excavation and backfill under this Section. Include payment in unit price or lump sum for construction of structures.
  - 2. Refer to Section 01270 - Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

**1.3 DEFINITIONS**

- A. Unsuitable Material: Unsuitable soil materials are the following:
  - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
  - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
  - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.
- C. Select Material: Material as defined in Section 02320 - Utility Backfill Materials.
- D. Backfill: Material meeting specified quality requirements, placed and compacted under controlled conditions around structures.
- E. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- F. Foundation Base: For foundation base material, use crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth,



level working surface for construction of concrete foundation.

- G. Foundation Subgrade: Foundation subgrade is surface of natural soil which has been excavated and prepared to support foundation base or foundation backfill, where needed.
- H. Ground Water Control Systems: Installations external to excavation such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Section 01578 - Control of Ground Water and Surface Water.
- I. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from excavation. Remove rain water and surface water which accidentally enters excavation as part of excavation drainage.
- J. Excavation Drainage: Removal of surface and seepage water in excavation by sump pumping and using French drains surrounding foundation to intercept water.
- K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below foundation as shown on Drawings, and backfilled with foundation backfill material.
- L. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins.

#### 1.4 REFERENCES

- A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600kN-m/m<sup>3</sup>)).
- B. ASTM D 1556 - Standard Test Method for Density of Soil in Place by Sand-Cone Method.
- C. ASTM D 2922 - Standard Test Methods for Density of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D 3017 - Standard Test Method for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).
- E. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- F. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.
- G. TxDOT Tex-110-E - Particle Size Analysis of Soils.
- H. Federal Regulations, 29 CFR, Part 1926, Standards - Excavation, Occupational Safety and Health Administration (OSHA).

#### 1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit work plan for excavation and backfill for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to excavation and backfill activities. Use descriptions, with supporting illustrations, sufficiently detailed to demonstrate to Project Manager that

procedures meet requirements of Specifications and Drawings.

- C. Submit excavation safety system plan.
  - 1. Submit excavation safety system plan in accordance with applicable OSHA requirements for excavations.
  - 2. Submit excavation safety system plan in accordance with requirements of Section 02260 - Trench Safety System, for excavations that fall under State and Federal trench safety laws.
- D. Submit ground and surface water control plan in accordance with requirements in this Section and Section 01578 - Control of Ground Water and Surface Water.
- E. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.
- F. Submit project record documents under provisions of Section 01785 - Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

## **1.6 TESTS**

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by City in accordance with requirements of Section 01454 - Testing Laboratory Services and as specified in this Section.
- B. Perform embedment and backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

## **PART 2 PRODUCTS**

### **2.1 EQUIPMENT**

- A. Perform excavation with equipment suitable for achieving requirements of this Specification.
- B. Use equipment which will produce degree of compaction specified. Compact backfill within 3 feet of walls with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to depth of fill at that time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

### **2.2 MATERIAL CLASSIFICATIONS**

- A. Use backfill materials conforming to classifications and product descriptions of Section 02320 - Utility Backfill Materials. Use classification or product description for backfill applications as shown on Drawings and as specified.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Conduct an inspection to determine condition of existing structures and other permanent installations.
- B. Set up necessary street detours and barricades in preparation for excavation if construction will affect traffic. Conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning devices at all times for streets and intersections where work is in progress, or where construction work is considered hazardous to traffic movements.
- C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 02260 - Trench Safety Systems.
- D. Remove existing pavements and structures, including sidewalks and driveways, in accordance with requirements of Section 02221 - Removing Existing Pavements and Structures.
- E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01578 - Control of Ground Water and Surface Water.

#### **3.2 PROTECTION**

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Section 01562 - Tree and Plant Protection.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Prevent erosion of excavations and backfill. Do not allow water to pond in excavations.
- E. Maintain excavation and backfill areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density at no additional cost to City.

#### **3.3 EXCAVATION**

- A. Perform excavation work so that underground structure can be installed to depths and alignments shown on Drawings. Use caution during excavation work to avoid disturbing surrounding ground and existing facilities and improvements. Keep excavation to absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Project Manager.
- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Project Manager and obtain instructions before proceeding in such areas.
- C. Immediately notify agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Project Manager and agency for any repairs or relocations, either temporary or permanent.
- D. Avoid settlement of surrounding soil due to equipment operations, excavation procedures, vibration, dewatering, or other construction methods.

- E. Provide surface drainage during construction to protect work and to avoid nuisance to adjoining property. Where required, provide proper dewatering and piezometric pressure control during construction.
- F. Conduct hauling operations so that trucks and other vehicles do not create dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner such that objectionable materials will not spill onto streets. Promptly clear away any dirt, mud, or other materials that spill onto streets or are deposited onto streets by vehicle tires.
- G. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed, replace those which are damaged or destroyed by Work.
- H. Provide sheeting, shoring, and bracing where required to safely complete Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect Work and adjacent structures or improvements. Use sheeting, shoring, and bracing to protect workmen and public conforming to requirements of Section 02260 - Trench Safety Systems.
- I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, cement stabilized sand, or other material approved by Project Manager and compact to 95 percent standard density.
- J. After completion of structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by Project Manager in writing that such temporary structures may remain. Remove sheeting, shoring and bracing in such a manner as to maintain safety during backfilling operations and to prevent damage to Work and adjacent structures or improvements.
- K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or other material approved by Project Manager and compact to 95 percent standard density.

### **3.4 HANDLING EXCAVATED MATERIALS**

- A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at sufficient distance from excavation to prevent slides or cave-ins.
- B. Provide additional backfill material in accordance with requirements of Section 02319 - Borrow, if adequate quantities of suitable material are not available from excavation and trenching operations at site.

### **3.5 DEWATERING**

- A. Provide ground water control per Section 01 57 23.12 - Control of Ground Water and Surface Water.
- B. Keep ground water surface elevation minimum of 2 feet below bottom of foundation base.
- C. Maintain ground water control as directed by Section 01 57 23.12 - Control of Ground Water and Surface Water and until structure is sufficiently complete to provide required weight to resist hydrostatic uplift with minimum safety factor of 1.2.

### **3.6 FOUNDATION EXCAVATION**

- A. Notify Project Manager at least 48 hours prior to planned completion of foundation excavations. Do not place foundation base until excavation is accepted by Project Manager.
- B. Excavate to elevations shown on Drawings, as needed to provide space for foundation base, forming level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or material as directed by Project Manager. Prior to placing material over it, recompact subgrade where indicated on Drawings, scarifying as needed, to 95 percent of maximum Standard Dry Density according to ASTM D 698. If specified level of compaction cannot be achieved, moisture condition subgrade and recompact until 95 percent is achieved, over-excavate to provide minimum layer of 24 inches of foundation backfill material, or other means acceptable to Project Manager.
- C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by Project Manager.
- D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement. E. Remove soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to required subgrade, and replace with foundation backfill material, as directed by Project Manager, at no additional cost to City.
- E. Place foundation base, or foundation backfill material where needed, over subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with seal slab or cement-stabilized sand.
- F. Use filter fabric as specified in Section 02621 - Geotextile to separate crushed aggregate, and other free draining Class I materials from native soils or select material backfill. Overlap fabric minimum of 12 inches beyond where another material stops contact with soil. H. Place crushed aggregate, and other Class I materials, in uniform layers of 8-inch maximum thickness. Perform compaction by means of at least two passes of vibratory compactor.

### **3.7 FOUNDATION BASE**

- A. Place foundation base after subgrade is properly prepared, including placement of foundation backfill where needed. Use foundation base consisting of 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, seal slab with minimum thickness of 4 inches may be placed. Extend foundation base minimum of 12 inches beyond edge of structure foundation, unless shown otherwise on Drawings.
- B. Where foundation base and foundation backfill are of same material, both can be placed in one operation.

### **3.8 BACKFILL**

- A. Complete backfill to surface of natural ground or to lines and grades shown on Drawings. Remove forms, lumber, trash and debris from structures. Deposit backfill in uniform layers and compact each layer as specified.
  - 1. Unless otherwise shown on Drawings, for structures under pavement or within one foot back of curb, use cement stabilized sand up to the top of the proposed structure. Use suitable on-site material (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or

subgrade.

2. Unless otherwise shown on Drawings, for structures not under pavement, use random backfill of suitable material up to the surface.
- B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that concrete has reached minimum of 85 percent of specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until slab or intermediate walls have been placed and concrete has attained sufficient strength.
  - C. Remove concrete forms before starting backfill and remove shoring and bracing as work progresses.
  - D. Maintain backfill material at no less than 2 percent below nor more than 2 percent above optimum moisture content, unless otherwise approved by Project Manager. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698 below paved areas. Compact fill to at least 90 percent around structures below unpaved areas.
  - E. Where backfill is placed against sloped excavation surface, run compaction equipment across boundary of cut slope and backfill to form compacted slope surface for placement of next layer of backfill.
  - F. Place backfill using cement stabilized sand in accordance with Section 02321 – Cement Stabilized Sand.

### **3.9 FIELD QUALITY CONTROL**

- A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.
- B. Tests will be performed initially on minimum of one different sample of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity.
- C. In-place density tests of compacted subgrade and backfill will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions:
  1. Minimum of one test for every 50 to 100 cubic yards of compacted backfill material as directed by Project Manager.
  2. A minimum of three density tests for each full work shift.
  3. Density tests will be performed in all placement areas.
  4. Number of tests will be increased when inspection determines that soil types or moisture contents are not uniform or when compacting effort is variable and not considered sufficient to attain uniform density.
  5. Identify elevation of test with respect to natural ground.
  6. Record approximate depth of lift tested.
- D. At least one test for moisture-density relationships will be initially performed for each type of backfill material in accordance with ASTM D 698. Perform additional moisture-density

relationship test once a month or whenever there is noticeable change in material gradation or plasticity.

- E. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at Contractor's expense.

**3.10 DISPOSAL OF EXCESS MATERIAL**

Dispose of excess materials in accordance with requirements of Section 01576 – Waste Material Disposal.

**END OF SECTION**

## **SECTION 31 23 16.14 - TRENCH SAFETY SYSTEM**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Trench Safety System for the construction of trench excavations.
- B. Trench Safety System for structural excavations that fall under provisions of State and Federal trench safety laws.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for Trench Safety is on a Linear Foot Basis.
- B. Stipulated Price (Lump Sum). The Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

#### **1.3 DEFINITIONS**

- A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- B. The Trench Safety System requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.
- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

#### **1.4 SUBMITTALS**

- A. Submittals shall conform to requirements of Division 1.
- B. Submit a safety program specifically for the construction of trench excavation. Design the Trench Safety Program to be in accordance with OSHA 29 CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.
- D. Review of the safety program by the Engineer will only be in regard to compliance with this specification and will not constitute approval by the Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.



## 1.5 REGULATORY REQUIREMENTS

- A. Install and maintain Trench Safety Systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. The Contractor is responsible for obtaining a copy of OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209.
- C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., § 756.021 (Vernon 1991).
- D. Reference materials, if developed for a specific project, will be issued with the Bid Documents.

## 1.6 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgments or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

## PART 2 PRODUCTS – Not Used

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install and maintain Trench Safety Systems in accordance with provisions of OSHA 29 CFR.
- B. Install specially designed Trench Safety Systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the Contractor's trench safety program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

### 3.2 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the Trench Safety Systems to ensure that the installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken by Contractor to safeguard personnel entering the trench.

- C. Maintain a permanent record of daily inspections.

**3.3 FIELD QUALITY CONTROL**

- A. Contractor shall verify specific applicability of the selected or specially designed Trench Safety Systems to each field condition encountered on the project.

**END OF SECTION 31 23 16.14**

## **SECTION 31 23 23 – FLOWABLE FILL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Flowable Fill for furnishing, mixing, transporting and placing flowable fill.
- B. Related Sections:
  - 1. Section 01 45 23 "Structural Testing and Inspection Services".
  - 2. Section 03 20 00 "Concrete Forming and Accessories".
  - 3. Section 03 30 00 "Cast-in-Place Concrete".
  - 4. Section 31 63 29 "Drilled Concrete Piers and Shafts".

#### **1.3 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for flowable fill under this Section. Include cost in unit prices for work, as specified in Section 01 22 00 – Unit Prices

#### **1.4 REFERENCES**

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
  - 1. ACI 116R – Cement and Concrete Terminology
  - 2. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
  - 3. ACI 229R – Controlled Low-Strength Materials
  - 4. ACI 230.1R – State-of-the-Art Report on Soil Cement
  - 5. ACI 232.2R – Use of Fly Ash in Concrete
  - 6. ACI 304.6R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
  - 7. ACI 325.3R – Guide for Design of Foundations and Shoulders for Concrete Pavements.
  - 8. ACI 523.1R – Guide for Cast-in-Place Low Density Concrete
  - 9. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the field.
  - 10. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 11. ASTM C 40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
  - 12. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
  - 13. ASTM C 150 - Standard Specification for Portland Cement.
  - 14. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
  - 15. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete.
  - 16. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
  - 17. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
  - 18. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

#### **1.4 DEFINITIONS**

- A. Flowable fill refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. This mixture is capable

of filling all voids in irregular excavations and hard to reach places (such as under undercuts of existing slabs), is self-leveling, and hardens in a matter of a few hours without the need for compaction in layers. Flowable fill is sometimes referred to as controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill.

- B. Flowable fill materials will be used only as a structural fill replacement. Unless otherwise noted, flowable fill installed as a substitution for structural earth fill, shall not be designed to be removed using hand tools. The materials and mix design for the flowable fill should be designed to produce comparable compressive strength to the surrounding soil after hardening, making excavation at a later time possible to produce the compressive strength indicated for the placed location, as determined by the engineer-of-record.

## 1.5 SUBMITTALS

- A. Submit proposed mix design
- B. Submit a copy of delivery tickets accompanied by batch tickets, providing the information required by ASTM C 94 to Engineer in the field at time of delivery.

## PART 2 – PRODUCTS

### 2.1 GENERAL

- C. Provide material conforming to:
  - 1. Cement- ASTM C 150, Type I.
  - 2. Fly Ash – ASTM C 618, Class C, with a minimum CaO content of 20 percent.
  - 3. Water- ASTM C 94.
  - 4. Fine Aggregate – Natural or manufactured fine aggregate, or a combination there of, free from deleterious amounts of salt, alkali, vegetable matter or other objectionable material. The plasticity index shall be 4 or less when tested in accordance with ASTM D 4318. Organic impurities, when tested in accordance with ASTM C 40, shall not show a color darker than the standard color. It is intended that the fine aggregate be fine enough to stay in suspension in the mortar to the extent required for proper flow. The fine aggregate shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8 inch	100
No. 200	0-10
  - 5. Admixtures – ASTM C 260 and /or C 494.

### 2.2 MIX DESIGN

- A. Mix design shall state the following information:
  - 1. Mix design number or code designation to order the concrete from the supplier.
  - 2. Design strength at 7 days (unless otherwise noted on the Plans).
  - 3. Cement type and brand.
  - 4. Fly ash type and brand.
  - 5. Admixtures type and brand.
  - 6. Proportions of each material used.
- B. Maximum strength requirement is 125 psi in 7 days, or at the time of desired excavation, unless otherwise noted on the plans.

### **PART 3 – EXECUTION**

#### **3.1 BATCHING, MIXING AND TRANSPORTATION**

- A. Batch, mix and transport flowable fill in accordance with ASTM C 94, except when directed otherwise by the Engineer.
- B. Mix flowable fill in quantities required for immediate use. Do not use portions which have developed initial set or which are not in place within 90 minutes after the initial water has been added.
- C. Do not mix flowable fill while the air temperature is at or below 35 degrees F. without prior approval of the Engineer.

#### **3.2 PLACEMENT**

- A. Seal off the area to be repaired.
- B. Monitor and control the fluid pressure during placement of flowable fill prior to set. Take appropriate measures to avoid excessive pressure that may damage or displace structures or cause flotation. Cease operations if flowable fill is observed leaking from the repair area. Repair or replace damaged or displaced structures at no additional cost.

#### **3.3 TESTING AND INSPECTION**

- A. Refer to Section 01 45 23 – Structural Testing and Inspections

#### **3.4 CLEAN UP**

- A. Clean up excess flowable fill discharged from the work area and remove excess flowable fill from pipes at no additional cost.
- B. Refer to Section 01 73 00 – Execution.

**END OF SECTION 31 23 23**

## **SECTION 31 23 33 - TRENCHING AND BACKFILLING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 DEFINITIONS**

- A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.
- D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
  - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
  - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
  - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
  - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.
- I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

- J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Division 1.
- K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
- L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
  - 1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
  - 2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
    - a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
    - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
    - c. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
- N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.
- O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.
- P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems include both protective systems and shoring systems as defined in Division 31.
- S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by

cave-in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

- T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.
- U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

#### **1.4 REFERENCES**

- A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
- B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.
- K. TxDOT Tex-110-E - Particle Size Analysis of Soils.
- L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

#### **1.5 SCHEDULING**

- A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

#### **1.6 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit planned typical method of excavation, backfill placement and compaction including:
  - 1. Trench widths.



2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
  3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
- C. Submit backfill material sources and product quality information in accordance with requirements of Division 31.
  - D. Submit trench excavation safety program in accordance with requirements of Division 31. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.
  - E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.
  - F. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Owner's Representative.

## 1.7 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by Owner in accordance with requirements of Division 1 and as specified in this Section.
- B. Perform backfill material source qualification testing in accordance with requirements of Division 31.

## 1.8 SPECIAL SHORING DESIGN REQUIREMENTS

- A. Have special shoring designed or selected by Contractor's Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre-manufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
- B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.
- C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.
- D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

## **2.2 MATERIAL CLASSIFICATIONS**

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Division 31.
- B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Division 31.
- C. Geotextile (Filter Fabric): Conform to requirements of Division 1.
- D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.
- E. Timber Shoring Left in Place: Untreated oak.

## **PART 3 EXECUTION**

### **3.1 STANDARD PRACTICE**

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- C. Classification of material will be determined by Owner's Representative.

### **3.2 PREPARATION**

- A. Establish traffic control to conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.
- B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Division 31.
- C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Division 2, as applicable.
- E. Install and operate necessary dewatering and surface-water control measures to conform to Division 1. Provide stable trench to allow installation in accordance with Specifications.
- F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Division 1.

### **3.3 CRITICAL LOCATION INVESTIGATION**

- A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on

Drawings, field verify horizontal and vertical locations of such lines within zone 2 feet vertically and 4 feet horizontally of proposed work.

1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
  2. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.
- B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.
- C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Owner's Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

**3.4 PROTECTION**

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Division 1.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to the Owner.

**3.5 EXCAVATION**

- A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.
- C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

Nominal Pipe Size, Inches	Minimum Trench Width, Inches
Less than 18	O.D. + 24
18 to 30	O.D. + 24

36 to 42	O.D. + 36
<u>Greater than 42</u>	<u>O.D. + 48</u>

- D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.
  
- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner’s Representative and obtain instructions before proceeding.
  
- F. Shoring of Trench Walls.
  - 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
  - 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
  - 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner’s Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
  - 4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
  - 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.
  
- G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
  - 1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
  - 2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.
  - 3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
  - 4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
  - 5. Conform to applicable Government regulations.

- H. Voids under or damages to paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports. Contractor is responsible for all cost associated with the repairs.
- I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company's representative.
- K. When, during excavation to uncover pipeline company's pipelines, screwed collar or an oxy-acetylene weld is exposed, immediately notify Owner's Representative. Provide supports for collar or welds. Discuss with Pipeline Company's representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

### **3.6 HANDLING EXCAVATED MATERIALS**

- A. Use only excavated materials, which are suitable as defined in this Section and conforming to Division 31. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.
- B. When required, provide additional backfill material conforming to requirements of Division 31.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with Division 1. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

### **3.7 TRENCH FOUNDATION**

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.
- B. When wet soil is encountered on trench bottom and dewatering system is not required, over excavate an additional 6 inches with approval by Owner's Representative. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.
- C. Perform over excavation, if directed by Owner's Representative, in accordance with Paragraph 3.07B above. Removal of unstable or unsuitable material may be required if approved by Owner's Representative:
  - 1. Even though Contractor has not determined material to be unsuitable, or
  - 2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Division 1.

- D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

### **3.8 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION**

- A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.
- B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.
- C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.
- D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.
- E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.
- H. Place electrical conduit, if used, directly on foundation without bedding.
- I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.
- J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Division 31. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:
  - 1. Class I, II and III Embedment Materials:
    - a. Maximum 6 inches compacted lift thickness.
    - b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
    - c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
  - 2. Cement Stabilized Sand (where required for special installations):
    - a. Maximum 6 inches compacted thickness.

- b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
    - c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.
  - 3. Class I Embedment Materials.
    - a. Maximum 6-inches compacted lift thickness.
    - b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
    - c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.
  - 4. Class II Embedment and Cement Stabilized Sand.
    - a. Maximum 6-inches compacted thickness.
    - b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
    - c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.
- K. Place trench dams in Class I embedment in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

### **3.9 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION**

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.
- B. For water lines, backfill in trench zone, including auger pits, intermediate and site pits, with bank run sand, select fill, or random backfill material as specified in Division 31.
- C. For sewer pipes, use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot back of curb, use cement stabilized sand to level 12 inches below the pavement. For sewer pipes under natural ground backfill from 12 inches above top of pipe to 6" inches below finish grade with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement. Use topsoil for 6-inch backfill directly under natural grade. For backfill materials reference Division 31.
- D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.
- E. When shown on Drawings, random backfill of suitable material may be used in trench zone for trench excavations outside pavements.
- F. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.
  - 1. Class I, II, III or IV or combination thereof (Random Backfill):
    - a. Maximum 9-inches compacted lift thickness.

- b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
- c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
- 2. Cement-Stabilized Sand:
  - a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
  - b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
  - c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
- 3. Select Backfill:
  - a. Place in maximum 8-inch loose layers.
  - b. Compaction by equipment providing tamping or kneading impact to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
  - c. Moisture content within 2 percent below or 5 percent above optimum determined according to ASTM D 698, unless approved by Owner's Representative.
- G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.
  - 1. Fat clays (CH) may be used as trench zone backfill outside paved areas at Contractor's option. When required density is not achieved, at no additional cost to Owner, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use different suitable material.
  - 2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
  - 3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D 698.
  - 4. Moisture content as necessary to achieve density.
- H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

### **3.10 MANHOLES, INLETS, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES**

- A. Meet requirements of adjoining utility installations for backfill of pipeline structures, as shown on Drawings.
- B. Below paved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement.
- C. In unpaved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of finish grade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use suitable on-site material and topsoil for the 12-inch backfill directly under natural ground.



### **3.11 FIELD QUALITY CONTROL.**

- A. Test for material source qualifications as defined in Division 1.
- B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.
- C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by Owner's Representative.
- D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.
  - 1. For open cut construction projects and auger pits: Unless otherwise approved by Owner's Representative, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.
  - 2. A minimum of three density tests for each full shift of Work.
  - 3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
  - 4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
  - 5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
  - 6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
  - 7. Recompacted placement will be retested at same frequency as first test series, including verification tests.
  - 8. Identify elevation of test with respect to natural ground or pavement.
- F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.
- G. Acceptability of crushed rock compaction will be determined by inspection.

### **3.12 DISPOSAL OF EXCESS MATERIAL**

- A. Dispose of excess materials in accordance with requirements of Division 1.

**END OF SECTION 31 23 33**

## **SECTION 31 31 16 - TERMITE CONTROL**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SECTION INCLUDES**

- A. Provide termite control at all slab conditions that are in contact with or within six (6) inches of finished grade, including, but not limited to around all piers and continuous along the exterior grade beams around the building.

#### **1.3 RELATED WORK**

- A. Section 31 00 00 - Earthwork: Building fill.
- B. Section 03 30 00 - Cast-In-Place Concrete: Under-slab membrane.

#### **1.4 COORDINATION**

- A. Each offeror shall be responsible for determining during the proposal period the extent that any addenda issued during the proposal period may affect this Section of the Specifications.
- B. Reference instructions to the offerors for requirements regarding substitutions of materials and products.
- C. Where conflicts occur between the Drawings and Specifications, between different drawings, between portions of this Section of the Specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.
- D. Contractor shall notify the School District Maintenance Department for a representative of the Department to be present at site for the application of termite treatment.
- E. Contractor shall notify Structural Pest Control Board (SPCB) prior to application of termite treatment at the site as required by the law.

#### **1.5 QUALITY ASSURANCE**

- A. Applicator shall be bonded and licensed with all applicable authorities.
- B. Products and application techniques shall meet all requirements of federal, state and local regulations regardless of products and techniques specified herein.

#### **1.6 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's printed literature describing products and detailed application requirements.
  - 2. Document that product is currently allowed by the Environmental Protection Agency, the State of Texas, and all applicable county and local authorities for use under building slabs.

- B. Sample: Of proposed written warranty.
- C. Certification:
  - 1. After completion of Work under this Section, submit manufacturers signed affidavit, verifying specification compliance of the chemicals, their proportions, and application.
  - 2. Contractor's certification that pesticide used on project does not contain the chemical ingredient known as "Dursban".

### **1.7 WARRANTY**

- A. Provide written warranty against defects in materials and application for a period of five (5) years after application.
- B. Defects shall include, but not be limited to the following:
  - 1. Evidence of activity by subterranean type termites.
  - 2. Damage of building materials due to subterranean termites.
- C. During the warranty period the applicator shall at his own expense provide additional termite treatment as required to prevent termite activity. Repair or replace building materials damaged by subterranean termite activity during the warranty period.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. "Dagnet SFR" 1.0% in water emulsion or "Prevail FT" manufactured by FMC Corporation. Emulsible concentrate insecticide for dilution with water, specially formulated to prevent infestation by termites.
- B. Potable water.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Notify all applicable authorities and the School District Maintenance Department within required time periods prior to beginning work.
- B. Inspect building earth fill and foundation excavation for readiness and to ensure that soils are not too wet for proper application of treatment.
- C. Post conspicuous warning signs indicating date(s) and time(s) of application.

### **3.2 APPLICATION**

- A. Mixing and treatment procedures shall be in strict accordance with chemical manufacturer's printed instruction.
- B. Apply after installation of building fill and immediately prior to installation of waterproof membrane.
- C. Apply four (4) gallons of chemical solution per each ten (10) lineal feet to soil along both sides of perimeter grade beams and around slab penetrations. Apply in trenching along beams or use earth probes as recommended by the chemical manufacturer. The final

treatment of the exterior beam will be performed within thirty (30) days of notification of completion of landscaping or one year from the date of completion of construction.

- D. Apply one (1) gallon of chemical solution per each ten (10) square feet as an overall treatment to soil under building, slabs-on-grade and to slabs-in-grade adjacent to building (courtyards, equipment pads, walks, etc.)
- E. Apply four (4) gallons of chemical solution per each ten (10) lineal feet to below grade construction (sump pits, elevator pits, etc.)
- F. Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities.
- G. All pesticide applications must be in compliance with S.P.C.B. Laws and regulations described in pre-treatment construction standards (Sect. 599.3 and 599.4).

**END OF SECTION 31 31 16**

## **SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
  - 1. Section 013200 "Construction Progress Documentation" for recording preexisting conditions and excavation support and protection system progress.
  - 2. Section 015000 "Temporary Facilities and Controls" for temporary utilities and support facilities.
  - 3. Section 312000 "Earth Moving"
  - 4. Section 312319 "Dewatering" for dewatering system for excavations.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
  - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
  - 4. Monitor vibrations, settlements, and movements.

#### **1.4 SUBMITTALS**

- A. Shop Drawings: For excavation support and protection system.
- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Other Informational Submittals:
  - 1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
  - 2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
    - a. Note locations and capping depth of wells and well points.

## 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify all impacted parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without Owner's written permission.
  
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
  - 2. The geotechnical report is referenced elsewhere in the Project Manual.
  
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations.
  - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Delete this article if Contractor selects temporary excavation support and protection. Revise materials if prescribing excavation support and protection system requirements.
  
- B. General: Provide materials that are either new or in serviceable condition.
  
- C. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
  
- D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
  - 1. Corners: Site-fabricated mechanical interlock or roll-formed corner shape with continuous interlock.
  
- E. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
  
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
  
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
  
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
  
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
  - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

#### **3.2 SOLDIER PILES AND LAGGING**

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

#### **3.3 SHEET PILING**

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

#### **3.4 TIEBACKS**

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
  - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.

2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

### **3.5 BRACING**

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
  1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
  2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
  3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### **3.6 REMOVAL AND REPAIRS**

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
  1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
  2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
  3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

**END OF SECTION 31 50 00**



## **SECTION 31 63 29 - DRILLED CONCRETE PIERS AND SHAFTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Dry-installed drilled piers.

#### **1.3 UNIT PRICES**

- A. Unit prices are included in Section 01 22 00 "Unit Prices."
- B. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
  - 1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, extended through the bell, if applicable, and the diameter of shaft and bell.
  - 2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.
- C. Trial Drilled Pier: Unit price as indicated for drilled pier, including backfilling.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.
- D. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Steel reinforcement and accessories.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
- F. Field quality-control reports.

- G. Other Informational Submittals:
  - 1. Record drawings.

### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.
- C. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.

### **1.6 PROJECT CONDITIONS**

- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
  - 1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
- B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify all affected parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without Owner's written permission.
- C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
  - 2. The geotechnical report is referenced elsewhere in the Project Manual.
- D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
  - 1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

## **PART 2 - PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Refer Section 03 20 00.

### **2.2 CONCRETE MATERIALS**

- A. Refer Section 03 30 00 and Structural General Notes.

### **2.3 STEEL CASINGS**

- A. Steel Pipe Casings: ASTM A 283, Grade C, or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.
- B. Corrugated-Steel Pipe Casings: ASTM A 929, steel sheet, zinc coated.

### **2.4 CONCRETE MIXTURES**

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Proportion normal-weight concrete mixture as follows:
  - 1. As indicated in Structural General Notes.

### **2.5 FABRICATING REINFORCEMENT**

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

### **2.6 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

### **3.2 EXCAVATION**

- A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
  - 1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.
  - 2. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.
- B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

- C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
  - 1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
  - 2. Remove water from excavated shafts before concreting.
  
- D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
  - 1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
  - 2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.
  
- E. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.
  
- F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
  - 1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
  
- G. Bells: Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before placing concrete.
  
- H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
  - 1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

### **3.3 STEEL REINFORCEMENT**

- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
  
- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
  
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.
  
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
  
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

### **3.4 CONCRETE PLACEMENT**

- A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
  - 1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface

laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

- B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
  - 1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
  - 2. Vibrate top 60 inches of concrete.
- C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
  - 1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.
- D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
  - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

### **3.5 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Drilled piers.
  - 2. Excavation.
  - 3. Concrete.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
  - 1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.
- D. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94.
  - 1. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
  - 2. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F and below and 80 deg F and above, and 1 test for each set of compressive-strength specimens.
  - 3. Compression Test Specimens: ASTM C 31; one set of four standard 6-inch x 12-inch cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.

4. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier but not more than one set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.
  5. If frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
  8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
  9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  10. Additional Tests: Testing and inspecting agency will make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.
    - a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
  11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
  12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports for each drilled pier as follows:
1. Actual top and bottom elevations.
  2. Actual drilled-pier diameter at top, bottom, and bell.
  3. Top of rock elevation.
  4. Description of soil materials.
  5. Description, location, and dimensions of obstructions.
  6. Final top centerline location and deviations from requirements.
  7. Variation of shaft from plumb.
  8. Shaft excavating method.
  9. Design and tested bearing capacity of bottom.
  10. Levelness of bottom and adequacy of cleanout.
  11. Ground-water conditions and water-infiltration rate, depth, and pumping.
  12. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
  13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
  14. Bell dimensions and variations from original design.
  15. Date and time of starting and completing excavation.

16. Inspection report.
17. Condition of reinforcing steel and splices.
18. Position of reinforcing steel.
19. Concrete placing method, including elevation of consolidation and delays.
20. Elevation of concrete during removal of casings.
21. Locations of construction joints.
22. Concrete volume.
23. Concrete testing results.
24. Remarks, unusual conditions encountered, and deviations from requirements.

**3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION 31 63 29**

## **SECTION 32 11 13.13 - LIME-TREATED SUBGRADES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Foundation course of lime stabilized natural subgrade material.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM D698 - Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb Rammer and 12 inch Drop.
- B. ASTM D1140 - Method of Test for Amount of Material in Soils Finer than the No. 200 Sieve.
- C. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D3017 - Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- G. TxDOT Tex-600-J - Lime Testing Procedure.
- H. Geotechnical Engineering Soils Report.

#### **1.4 SUBMITTALS**

- A. Submittals shall conform to requirements of Division 1.
- B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.
- D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

#### **1.5 TESTS**

- A. Testing will be performed under provisions of Section - Testing Laboratory Services.
- B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.
- C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.



- D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.
- E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to sub grade material.
- F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.
- B. Store lime in weatherproof enclosures. Protect lime from ground dampness.
- C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

### **PART 2 PRODUCTS**

#### **2.1 WATER**

- A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

#### **2.2 LIME**

- A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.
- B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.
- C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:
  - 1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.
  - 2. Grade S: Finely-graded quicklime for use in the preparation of slurry for wet placing. Do not use grade S quicklime for dry placing.
- D. Lime shall conform to requirements of Item 260 of the 1993 Texas Department of Transportation Standard Specifications.
- E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify compacted sub grade is ready to support imposed loads.
- B. Verify sub grade lines and grades are correct.

### **3.2 PREPARATION**

- A. Complete backfill of new utilities below future grade.
- B. Cut material to bottom of sub grade using an approved cutting and pulverizing machine meeting following requirements:
  - 1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.
  - 2. Visible indication that cut is to proper depth.
- C. Alternatively, scarify or excavate to bottom of stabilized sub grade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

### **3.3 LIME SLURRY APPLICATION**

- A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.06C concerning use of quicklime.
- B. Apply slurry with a distributor truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.
- C. Apply so that dry sub grade will contain a minimum lime content of 7 percent by weight of dry sub grade unless otherwise instructed by Testing Laboratory.

### **3.4 PRELIMINARY MIXING**

- A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.
- B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.
- C. Shape mixed sub grade to final lines and grades.
- D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:
  - 1. Seal sub grade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.
  - 2. Cure soil-lime material for 1 to 4 days. Keep sub grade moist during cure.

### **3.5 FINAL MIXING**

- A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.
- B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.
- C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.
- D. Shape mixed sub grade to final lines and grades.
- E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

### **3.6 COMPACTION**

- A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.
- B. Start compaction immediately after final mixing, unless approved by Engineer.
- C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.
- D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.
- E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.
- F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:
  - 1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.
  - 2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.
- G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.

### **3.7 CURING**

- A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Sub grade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.
- B. Keep sub grade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

- C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from the Engineer.

### **3.8 TOLERANCES**

- A. Completed surface shall be smooth and conform to typical section and established lines and grades.
- B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16 foot length.

### **3.9 FIELD QUALITY CONTROL**

- A. Testing will be performed under provisions of Section - Testing Laboratory Services.
- B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.
- C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.
  - 1. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at random locations near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.
- D. Fill test sections with new compacted lime stabilized sub grade.

### **3.10 PROTECTION**

- A. Maintain stabilized sub grade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.
- B. Repair defects immediately by replacing material to full depth.

**END OF SECTION 32 11 13.13**

## **SECTION 32 13 13 - CONCRETE PAVING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Portland cement concrete paving.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for concrete paving will be on a square yard basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- B. ASTM A 185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
- D. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- E. ASTM C 33 - Standard Specifications for Concrete Aggregates.
- F. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- G. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- H. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- I. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).
- J. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- K. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- L. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- M. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- N. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

- O. ASTM C 150 - Standard Specification for Portland Cement.
- P. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
- Q. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- S. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- T. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- U. TxDOT Tex-203-F - Sand Equivalent Test.
- V. TxDOT Tex-406-A - Material Finer than 75 Fm (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.
- C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.
- D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82. Provide specimens for testing when required by Owner's Representative.
- E. CHPS Submittals:
  - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

#### **1.5 HANDLING AND STORAGE**

- A. Do not mix different classes of aggregate without written permission of Owner's Representative.
- B. Class of aggregate being used may be changed before or during Work with written permission of Owner's Representative. Comply new class with specifications.
- C. Reject segregated aggregate. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.
- D. Reject aggregates mixed with dirt, weeds, or foreign matter.
- E. Do not dump or store aggregate in roadbed.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Portland Cement:
  - 1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
  - 2. Bulk cement which meets referenced standards may be used when method of handling is approved by Owner's Representative. When using bulk cement, provide satisfactory weighing devices.
  - 3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by Owner's Representative.
- B. Water: Conform to requirements for water in ASTM C 94.
- C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).
  - 1. Maximum percentage by weight of deleterious substances shall not exceed following values:

<u>Item</u>	<u>Percent by Weight of Total Sample Maximum</u>
Clay lumps and friable particles	3.0
Material finer than 75-um (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All other concrete	5.0*
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

\* In case of manufactured sand, when material finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

- 2. Conform coarse aggregate (size 1 1/2 inch to No. 4 sieve) to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 1¾" sieve	0
Retained on 1½" sieve	0 to 5
Retained on ¾" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test	
*Method Tex-406-A	1.0 maximum

\* In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to 1.5.

- D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.
- E. Mineral Filler: Type "C" or Type "F" fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture as approved by the Engineer. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementitious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.
- F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.
- G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Owner's Representative.
- H. Reinforcing Steel:
1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.
  2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.
  3. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A 185.

## 2.2 EQUIPMENT

- A. Conform Equipment to requirements of ASTM C 94.



## 2.3 MIXING

- A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.
- B. Mix design to produce concrete which will have minimum compressive strength of 3,000 psi at 7 days and 3,500 psi at 28 days. Slump of concrete shall be at least 2 inches but no more than 5 inches, when tested in accordance with ASTM C 143.
  - 1. Concrete pavement, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
  - 2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.
  - 3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.
  - 4. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.
- C. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:
  - 1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.
  - 2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.
  - 3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5 inches, when tested in accordance with ASTM C 143.
  - 4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Division 32.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify compacted base is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

### 3.2 PREPARATION

- A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.
- B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

### 3.3 EQUIPMENT

- A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.
  
- B. Subgrade Planer and Template:
  - 1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.
  - 2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.
  
- C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.
  
- D. Hand Finishing:
  - 1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
  - 2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.
  
- E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10 ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3 foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.
  
- F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.
  
- G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Meet requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use and use conventional methods.
  - 1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.

2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.
3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

### **3.4 FORMS**

- A. Side Forms: Use forms of approved shape and section. Form depth shall be equal to required edge thickness of pavement. Forms with depths greater or than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used.
- B. Form Setting:
  1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Owner's Representative.
  2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

### **3.5 REINFORCING STEEL AND JOINT ASSEMBLIES**

- A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
- B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.
- C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.
- D. Secure in required position to prevent displacement during placing and finishing of concrete.
- E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.

- F. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

### **3.6 FIBROUS REINFORCING**

- A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

### **3.7 PLACEMENT**

- A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.
- B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
- C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.
- D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.
- E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

### **3.8 COMPACTION**

- A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.
- B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

### **3.9 FINISHING**

- A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.
  - 1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

- B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.
- C. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

### **3.10 JOINTS AND JOINT SEALING**

- A. Conform to requirements of Division 32.

### **3.11 CONCRETE CURING**

- A. Conform to requirements of Division 32.

### **3.12 TOLERANCES**

- A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10 foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

### **3.13 FIELD QUALITY CONTROL**

- A. Perform testing under provisions of Division 1.
- B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test two specimens at 7 days or at number of hours as directed by the Owner's Representative for high early strength concrete. Test remaining two specimens at 28 days. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.
- C. When compressive test indicates failure, make yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. Minimum of one 4 inch core will be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.

- E. Request, at option, three additional cores in vicinity of cores indicating nonconforming in-place depths at no cost to Owner. In-place depth at these locations shall be average depth of four cores.
- F. Fill cores and density test sections with new concrete paving or non shrink grout.

### **3.14 NONCONFORMING PAVEMENT**

- A. Remove and replace areas of pavement found deficient in thickness, or that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. When measurement of any core is less than specified thickness, actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced. Replace nonconforming pavement sections at no additional cost to Owner.

### **3.15 PAVEMENT MARKINGS**

- A. Restore pavement markings to match those existing in accordance with the applicable governmental standard specifications and details and Owner's Representative's requirements.

### **3.16 PROTECTION**

- A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.
- B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Owner's Representative.
- C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.
- D. Maintain concrete paving in good condition until completion of Work.
- E. Repair defects by replacing concrete to full depth.

**END OF SECTION 32 13 13**

## **SECTION 32 13 13.10 - CONCRETE PAVEMENT CURING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Curing of Portland cement concrete paving.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for concrete curing shall be incidental to concrete paving.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.
- B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

### **PART 2 PRODUCTS**

#### **2.1 COVER MATERIALS FOR CURING**

- A. Conform curing materials to one of the following:
  - 1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.
  - 2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.
  - 3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

#### **2.2 LIQUID MEMBRANE-FORMING COMPOUNDS**

- A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m<sup>2</sup> in 72 hours using test method ASTM C 156.

## **PART 3 EXECUTION**

### **3.1 CURING REQUIREMENT**

- A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.
- B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

### **3.2 POLYETHYLENE FILM CURING**

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.
- B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

### **3.3 WATERPROOFED PAPER CURING**

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.
- B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

### **3.4 COTTON MAT CURING**

- A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.
- B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

### **3.5 LIQUID MEMBRANE-FORMING COMPOUNDS**

- A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.
- B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.
- C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by Owner's Representative, but not less than one gallon per 200 square feet of surface area.



**3.6 TESTING MEMBRANE**

- A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface.
- B. Re-Apply membrane compound immediately at no cost to Owner when membrane fails above test.

**END OF SECTION 32 13 13.10**

## **SECTION 32 13 13.25 - CONCRETE SIDEWALKS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Reinforced concrete sidewalks.
- B. Wheelchair ramps.
- C. Reinforced slope paving.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.
- B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statutes.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. CHPS Submittals:
  - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Concrete: Conform to material and proportion requirements for concrete of Division 32.
- B. Reinforcing Steel: Conform to material requirements of Division 32. Use No. 3 reinforcing bars.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Division 31.
- E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.
- F. Sand Bed: Conform to material requirements for bank run sand of Division 31.
- G. Sodding: Conform to material requirements for sodding of Division 31.
- H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Division 31. Color shall be Brick Red or as shown on the drawings.

## **PART 3 EXECUTION**

### **3.1 REPLACEMENT**

- A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.
- B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

### **3.2 PREPARATION**

- A. Identify and protect utilities which are to remain.
- B. Protect living trees, other plant growth, and features designated to remain.
- C. Conduct clearing and grubbing operations in accordance with Division 31.
- D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance with Division 31. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.
- E. Immediately after subgrade is prepared, begin form work and concrete placement.

### 3.3 PLACEMENT

- A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.
- B. Reinforcement:
  - 1. Install reinforcing bars.
  - 2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.
  - 3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
  - 4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.
  - 5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.
- C. Expansion Joints: Install expansion joints with load transfer units in accordance with Division 32.
- D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.
- E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.
- F. Apply coating to wheelchair ramp with contrasting color in accordance with Division 32.
- G. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.
- H. Finish edges with tool having 1/4 inch radius.
- I. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Division 1. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Division 32.

### 3.4 CURING

- A. Conform to requirements of Division 32.

### 3.5 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

- C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. If the Contractor places concrete without notifying the laboratory, the Owner will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.
- E. Sampling of fresh concrete shall be in accordance with ASTM C 172.
- F. Take slump tests when cylinders are made and when concrete slump appears excessive.
- G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.
- H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.
- I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Owner's Representative. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

### **3.6 NONCONFORMING CONCRETE**

- A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. Replace nonconforming sections at no additional cost to Owner.

### **3.7 PROTECTION**

- A. Maintain newly place concrete in good condition until completion of Work.
- B. Replace damaged areas.

**END OF SECTION 32 13 13.25**

## **SECTION 32 13 73 - CONCRETE PAVING JOINTING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.
- B. Saw-cutting existing concrete or asphalt pavements for new joints.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No separate payment for street pavement expansion joints. Include cost for work in unit price bid for related work.
  - 2. No separate payment for saw-cutting existing concrete or asphalt pavement for new joints. Include cost for work in unit price bid for related work.
  - 3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include cost for work in unit price bid for related work.
  - 4. No separate payment will be made for joints for curb, curb and gutter, concrete sidewalks, and concrete driveways. Include cost for work in unit price bid for related work.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.
- E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit product data for joint sealing compound and proposed sealing equipment for approval.
- C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

## **PART 2 PRODUCTS**

### **2.1 BOARD EXPANSION JOINT MATERIAL**

- A. Filler board of selected stock. Use wood of density and type as follows:
  - 1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
  - 2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

### **2.2 PREFORMED EXPANSION JOINT MATERIAL**

- A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

### **2.3 JOINT SEALING COMPOUND**

- A. Provide joint sealant as indicated on the drawings.

### **2.4 LOAD TRANSMISSION DEVICES**

- A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.
- B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

### **2.5 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY**

- A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Owner's Representative.

## **PART 3 EXECUTION**

### **3.1 PLACEMENT**

- A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.
- B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling, or cracks.

### **3.2 CONSTRUCTION JOINTS**

- A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

### **3.3 EXPANSION JOINTS**

- A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart or as shown on the drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint.

Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

### **3.4 CONTRACTION JOINTS**

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

### **3.5 LONGITUDINAL WEAKENED PLANE JOINTS**

- A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

### **3.6 SAWED JOINTS**

- A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.
- B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

### **3.7 JOINTS FOR CURB, CURB AND GUTTER**

- A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

### **3.8 JOINTS FOR CONCRETE SIDEWALKS**

- A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 40 feet.

### **3.9 JOINTS FOR CONCRETE DRIVEWAYS**

- A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

### **3.10 JOINT SEALING**

- A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.



- B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Owner's Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.
- C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.
- D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

### **3.11 PROTECTION**

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joints material with new material as required by this Section.

**END OF SECTION 32 13 73**

## **SECTION 32 16 13 - CURBS AND GUTTERS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.
- B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb, when included on the bid form, is on a linear foot basis measured along face of curb.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit details of proposed form work for approval.
- C. CHPS Submittals:
  - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Concrete: Conform to material and proportion requirements for concrete of Division 32.
- B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Division 32.
- C. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to following requirements.
  - 1. Compressive strength
    - a. at 7 days: 3500 psi
    - b. at 28 days: 4000 psi
  - 2. Initial set time: 45 minutes
  - 3. Final set time: 1.5 hours
- D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.

- E. Expansion Joint Filler: Conform to material requirements for expansion joint filler of Division 32.
- F. Mortar: Mortar finish composed of one part Portland cement and 1 1/2 parts of fine aggregate. Use only when approved by Owner's Representative.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Prepare subgrade in accordance with applicable portions of sections on excavation and fill, embankment, and sub grade and roadbed.

#### **3.2 PLACEMENT**

- A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Ensure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.
- B. Forms: Brace to maintain position during pour. Use metal templates cut to section shown on Drawings.
- C. Reinforcement: Secure in position so that steel will remain in place throughout placement. Reinforcing steel shall remain at approximate center of base or pavement as indicated on Drawings.
- D. Joints: Place in accordance with Division 32. Place dummy groove joints at to match concrete pavement joints at right angles to curb lines. Cut dummy grooves 1/4 inch deep using approved edging tool.
- E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

#### **3.3 MANUAL FINISHING**

- A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.
- B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.
- C. Before applying final finish move 10 foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.
- D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.
- E. Edge outer edge of gutter with 1/4 inch edger. Finish edges with tool having 1/4 inch radius.
- F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

### **3.4 MECHANICAL FINISHING**

- A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, when approved by Owner's Representative. Use of mechanical methods shall provide specified curb design and finish.

### **3.5 CURING**

- A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Division 32.

### **3.6 TOLERANCES**

- A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of straightedge laid along them, except at grade changes.

### **3.7 PROTECTION**

- A. Maintain curbs and gutters in good condition until completion of Work.
- B. Replace damaged curbs and gutters to comply with this Section.

**END OF SECTION 32 16 13**

## **SECTION 32 17 23 - PAVEMENT MARKINGS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. This Section specifies the requirements for providing pavement markings of the following types.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for pavement markings will be on a lump sum basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 QUALITY ASSURANCE**

- A. All markings shall comply with the requirements of the SDHPT Standard Specifications for Construction of Highways, Streets and Bridges, the SDHPT Manual on Uniform Traffic Control Devices for Streets and Highways and the applicable regulations and standards of Harris County, Texas and the City.

- B. Reference Standards Applicable to this Section:

- 1. SDHPT: Texas State Department of Highways and Public Transportation:
  - a. Standard Specifications for Construction of Highways, Streets and Bridges.
  - b. Texas Manual on Uniform Traffic Control Devices for Streets and Highways (TMUTCD).
  - c. The above referenced SDHPT standards may be obtained from:  
  
State Department of Highways & Public Transportation Highway Building  
11th and Brazos Streets  
Austin, Texas 78701  
Tel: (512) 475-2081

- 2. Conform to current federal VOC (Volatile Organic Compounds) regulations.

#### **1.4 SUBMITTALS**

- A. Certificates:
  - 1. Certificates shall be submitted for each product indicating that the product complies with the requirements of this specification.

B. Manufacturer's Data:

1. Manufacturer's installation instructions, specifications and recommendations shall be submitted for each pavement marking product.

**1.5 JOB CONDITIONS**

A. Markings shall be installed only on clean and dry surfaces. Paint markings shall be applied only when surfaces have the following minimum temperatures:

1. A minimum of 50 degrees F for asphalt and a minimum of 60 degrees F for concrete.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. Paint:

1. Marking paint shall be traffic white, yellow, or as designated on the drawings.
2. Fast Drying Alkyd, Low VOC Chlorinated Rubber Traffic Paint.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- A. Markings shall be installed and surfaces prepared in accordance with the requirements of the applicable item in the SDHPT Standard Specifications and the TMUTCD.
- B. Markings shall be protected from vehicular traffic until not subject to damage by such traffic. Contractor shall be responsible for repair and replacement of markings until written acceptance by the Owner.

**END OF SECTION 32 17 23**

## **SECTION 32 31 13-CHAIN LINK FENCE AND GATES**

### **PART 1 – GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Chain-link fences.
  - 2. Swing gates.
  - 3. Horizontal-sliding gates.

#### **1.3 REFERENCES**

- A. ASTM International (ASTM)
  - 1. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
  - 2. F567, Standard Practice for Installation of Chain Link Fence.
  - 3. F626, Standard Specification for Fence Fittings.
  - 4. F900, Standard Specification for Industrial and Commercial Swing Gates.
  - 5. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded for Fence Structures.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's schedules, charts, literature, and illustrations indicating the performance, fabrication procedures, product variations and accessories indicating material compliance and specified options.
  - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicate materials, dimensions, details, and finish, show locations and installation procedures. Include details of fence and gate joints, attachments, accessories, footings, and clearances.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Specifications are based on products of Anchor Fence by Master Halco Inc., Baltimore, MD, Phone (800) 229-5615.
- B. Other manufacturers must have a minimum of five (5) years experience manufacturing chain link fencing and gates meeting or exceeding the following specifications for design, size, gauge, finish of metal parts and fabrication and comply with Division 1 requirements for substitutions in order to be considered.
  - 1. American Fence and Supply Co.; League City, TX (281) 332-0511.
  - 2. Merchants Metals, Houston, TX; (800) 254-0080.

#### **2.2 CHAIN LINK FENCE MATERIALS**

- A. Fence Fabric:
  - 1. Hot dipped galvanized after weaving with a minimum zinc coating weight per ASTM A392, Class I with weight of zinc coating not less than 1.2 oz/ft<sup>2</sup> of uncoated wire surface.
  - 2. Size: Helically wound and woven to height of six (6) feet and ten (10) feet with two (2) inch diamond mesh, with core wire diameter of 0.148 inch (9 gauge) and a breakload of 1,290 lbf.
  - 3. Selvage of fabric shall be knuckled at top and knuckled at bottom.
  
- B. Fence Framing:
  - 1. Steel pipe - Type I: ASTM F1083, standard weight Schedule 40; minimum yield strength of 25,000 psi; sizes as indicated below. Hot-dipped galvanized with minimum average 1.8 oz/ft<sup>2</sup> of coated surface area.
    - a. Line posts: 2 inch o.d, weighing 2.72 lb/ft.
    - b. Terminal, End, Corner, and Pull Posts: 2-1/2 inch o.d., weighing 3.65 lb/ft.
    - c. Rails and Braces: 1-5/8 inch o.d., weighing 2.27 lb/ft.
  
- C. Fence Accessories:
  - 1. Chain Link Fence Accessories: Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.
  - 2. Post Caps: Formed steel, cast malleable iron, or aluminum alloy weathertight closure cap for tubular posts. Provide one (1) cap for each post. (Where top rail is used, provide tops to permit passage of top rail).
  - 3. Top Rail and Brace Rail Ends: Formed steel, malleable or cast iron, for connection of rail and brace to terminal posts.
  - 4. Top Rail Sleeves: 6 inch sleeve allowing for expansion and contraction of top rail.
  - 5. Wire Ties: 9 gauge galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge for rails and braces. Hog ring ties of 12-1/2 gauge for attachment of fabric to tension wire.
  - 6. Brace and Tension (Stretcher Bar) Bands: Pressed steel.
  - 7. Tension (Stretcher) Bars: One piece lengths equal to 2 inches less than full height of fabric with a minimum cross-section of 3/16 inch x 3/4 inch or equivalent fiber glass rod. Provide tension (stretcher) bars where chain link fabric meets terminal posts.
  - 8. Tension Wire: 7 gauge, diameter core wire with tensile strength of 75,000 psi.
  - 9. Truss Rods: Steel rods with minimum diameter of 5/16 inch.
  - 10. Fasteners: Galvanized nuts and bolts.

### **2.3 CHAIN LINK SWING GATES**

- A. Gate Frames: Fabricate chain link swing gates in accordance with ASTM F900 using galvanized steel tubular members, 2 inches square, weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit.
  
- B. Chain Link Fence Fabric: Same as specified above for fence. Install fabric with hook bolts and tension bars at all four (4) sides. Attach to gate frame at not more than 15 inches on center.
  
- C. Hardware Materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size.
  - 1. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees inward.
  - 2. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.
  - 3. Keeper: Provide keeper for each gate leaf over five (5) feet wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.



4. Drop Rod: Provide at double gates to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one (1) padlock for locking both gate leaves.
- D. Gate Posts: Steel pipe, ASTM F1083, standard weight Schedule 40; minimum yield strength of 25,000 psi. Hot-dipped galvanized with minimum 1.8 oz/ft<sup>2</sup> of zinc. Sizes as follows:
  1. Width for single gate or one gate leaf of double gates:
    - a. 6 feet or less: 2.875 inches in diameter, weighing 5.79 lb/ft.
    - b. Over 6 feet to 12 feet: 4.00 inches in diameter, weighing 9.11 lb/ft.
    - c. Over 12 feet to 19 feet: 6.625 inches in diameter, weighing 18.97 lb/ft.
    - d. Over 19 feet to 23 feet: 8.625 inches in diameter, weighing 28.55 lb/ft.

## 2.4 HORIZONTAL SLIDE GATES

- A. ASTM F 1184 for gate posts and double sliding gate types.
  1. Classification: Type II Cantilever Slide, Class 1 with external roller assemblies.
    - a. Gate Frame Width and Height: More than 48 inches (1220 mm) wide by any height, as indicated.
- B. Pipe and Tubing:
  1. Zinc Coated Steel: Protective coating and finish to match fence framework.
  2. Gate Posts: ASTM F 1184. Provide round tubular steel posts.
  3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Hardware:
  1. Hangers, Roller Assemblies, and Stops: Fabricated from galvanized steel or galvanized malleable iron.
  2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
  3. Padlock and chain.
- E. Accessories: Sensor activated at exit side. Refer to Division 28.

## 2.6 SETTING MATERIALS

- A. Concrete: Minimum 28 day compressive strength of 3,000 psi.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Ensure property lines and legal boundaries of work are clearly established.

### 3.2 CHAIN LINK FENCE FRAMING INSTALLATION

- A. Install chain link fence in accordance with ASTM F567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
- C. Space line posts uniformly at 10 feet on center.

- D. Concrete fence post footings:
  - 1. Drill holes in firm, undisturbed or compacted soil. Excavate deeper than specified below as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
  - 2. Line posts shall be set in 9 inch minimum diameter concrete piers, with a minimum of 36 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
  - 3. All end, corner, and pull posts shall be set in minimum 12 inch minimum diameter concrete piers, with a minimum of 36 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
  - 4. Place concrete around posts in a continuous pour.
  - 5. Trowel finish around post. Slope to direct water away from posts.
- E. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- F. Bracing: Install horizontal pipe brace at mid-height for fences six (6) and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- G. Tension Wire: Provide tension wire at bottom of fabric. Install tension wire before stretching fabric and attach to each post with ties. Secure tension wire to fabric with 12-1/2 gauge hog rings 24 inches on center.
- H. Top Rail: Install lengths, 21 feet. Connect joints with sleeves for rigid connections for expansion/contraction.
- I. Bottom Rails: Install bottom rails between posts with fittings and accessories.

### **3.3 CHAIN LINK FABRIC INSTALLATION**

- A. Fabric: Install fabric on security side and attach so that fabric remains in tension after pulling force is released. Leave approximately 2 inches between finish grade and bottom selvage. Attach fabric with wire ties to line posts at 15 inches on center and to rails, braces, and tension wire at 24 inches on center.
- B. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15 inches on center.

### **3.4 ACCESSORIES**

- A. Tie Wires: Bend ends of wire to minimize hazard to persons and clothing.
- B. Fasteners: Install nuts on side of fence opposite fabric side for added security.
- C. Selvage: Twist and knuckle.

### **3.5 CHAIN LINK SWING GATE POST INSTALLATION**

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete gate post footings:
  - 1. Drill holes in firm, undisturbed or compacted soil. Excavate deeper than specified below as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.

2. All gate posts shall be set in minimum 12 inch diameter concrete piers, with a minimum of 36 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
  3. Place concrete around posts in a continuous pour.
  4. Trowel finish around post. Slope to direct water away from posts.
- C. Gate posts and hardware: Set keeper, stops, sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

**3.6 GATE INSTALLATION**

- A. Install gates plumb, level, and secure for full opening without interference.
- B. Attach hardware by means which will prevent unauthorized removal.
- C. Adjust hardware for smooth operation.

**3.7 CLEANING**

- A. Clean up debris and unused material, and remove from the site.

**END OF SECTION 32 31 13**

## **SECTION 32 31 13.27 - TENNIS COURT WINDSCREEN**

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Tennis court windscreen.

#### **1.2 SUBMITTALS**

- A. Shop Drawings: Indicate materials, dimensions, details, and finish, show locations and installation procedures. Include details of fence and gate joints, attachments, accessories, footings, and clearances.
- B. Product Data: Manufacturer's schedules, charts, literature, and illustrations indicating the performance, fabrication procedures, product variations and accessories indicating material compliance and specified options.

### **PART 2 - PRODUCTS**

#### **2.4 TENNIS COURT WINDSCREENS**

- A. Custom made polypropylene open mesh fabric windscreen as follows:
  - 1. Type: 100% polypropylene
  - 2. Windbreak: 85 percent
  - 3. Weight/Sq. Yd.: 7.0 ounces
  - 4. Tensile Strength: 380 x 185
  - 5. Hems: Reinforced 4-Ply Hems with #2 Brass Grommets Every 18" Top, Bottom (and center if applicable) and every 12" on Sides.
  - 6. Color: Black, unless noted otherwise.
  - 7. Accessories: Provide all anchors, ties, and other accessories required for attachment to chain link fencing.
  - 8. Warranty: Manufacturer's four (4) year warranty.
  - 9. Number/Size/Locations: As shown on drawings.
  - 10. Approved Product/Manufacturer: Douglas Windscreen – Douglas-Sports.com or preapproved equivalent.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that the areas to receive fencing have been completed to the final grades and elevations.
- B. Ensure property lines and legal boundaries of work are established.

#### **3.2.1 WINDSCREEN INSTALLATION**

- A. Install 9-foot high windscreens on all fencing where indicated on the drawings. Install windscreens on the court side of the fence fabric. Fasten windscreens to the fence fabric at the top and sides

with standard tie straps capable of withstanding 50 pounds of pressure. Use hog rings at the bottom. Center windscreen between the court elevation and the top rail of the fence.

### **3.2.2 CLEANING**

- A. Clean up debris and unused material and remove it from the site.

**END OF SECTION 32 31 13.27**

## **SECTION 32 31 19 – DECORATIVE METAL FENCES AND GATES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This section includes the following:
  - 1. Steel ornamental fences with solid steel pickets.
  - 2. Pedestrian gates.
  - 3. Expanded Metal Panel.
  - 4. Manual and Motorized Cantilevered sliding gates
- B. Related Sections include the following:
  - 1. Division 2 Section "Earthwork" for filling and for grading work.
  - 2. Division 3 Section "Cast-in-Place Concrete" for concrete post footings.

#### **1.3 DEFINITIONS**

- A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

#### **1.4 SUBMITTALS**

- A. Submit product data in the form of manufacturer's technical data, specifications, and installation instructions for fences and gates.
- B. Shop Drawings: Submit shop drawings showing location of fence and gates, including each post, details of post installation, hardware, and accessories. Show sizes and thicknesses of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work, and other pertinent details of fabrication and installation.
- C. Samples for Verification: Submit samples for each profile and pattern of fabricated metal and for each type of metal finish required, prepared on metal of same thickness and alloy indicated for the Work. Include samples of the following:
  - 1. Post cap including 12 inch (300-mm) long section of post.
  - 2. Full-size sample of fence, 2 feet wide by full height.
  - 3. Gate hardware including hinges and latch.
- D. Qualification Data: Submit qualification data for fabricator.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Arrange for installation of ornamental metal fences and gates specified in this Section by the same firm that fabricated it.

- B. Fabricator Qualifications: A firm experienced in producing ornamental metal fences and gates similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

## 1.6 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

## 1.7 WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

## PART 2 - PRODUCT

### 2.1 MANUFACTURER

- A. Provide ornamental metal fences and gates as manufactured by Montage II—Heavy Industrial Plus standard picket space Steel Ornamental Fence System as manufactured by Ameristar Fence Products, Inc. (918) 835-0898 or comparable product approved by the Architect.

### 2.2 MATERIALS

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft<sup>2</sup> (276 g/m<sup>2</sup>), Coating Designation G-90.

- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.5 inch x 1.4375 inch x 14 Ga. Picket holes in the rail shall be spaced 4.7615" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

### 2.3 FABRICATION, GENERAL

- A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets. Pickets are to be flushed.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
  - 1. Color: Architect to select from manufacturer's full range.
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48" width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.
- G. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- F. Expanded Metal: 3/4 inch, #9 galvanized expanded metal infill. Refer to the Drawings for locations.



**2.4 MANUAL CANTILEVERED SLIDING GATES**

- A. Basis of Design: Passport Commercial Roll Gate, Majestic style as manufactured by Ameristar Fence Products, Inc. or comparable product to be approved by Architect.
- B. Material: Steel material for roll gate components of pickets, rails, diagonals, and uprights shall be commercial steel with a minimum yield strength of 45,000 psi.
- C. Ornamental picket material shall be 3/4 inch square x 14 Ga. tubing. Picket spacing shall be 4-5/8 inch. Material for top rails, uprights and diagonals rails shall be 2 inch square x 12 Ga. Material for bottom rail shall be 2 inch x 4 inch x 11 Ga. Posts shall be a minimum of 4 inch square x 11 Ga.
- D. Pickets, rails, uprights and posts shall be precut to specified lengths. Diagonals shall be precut to specified lengths and angles. Frame materials shall be joined by welding. Pickets shall be face welded to roll gate frame, except for Invincible gates over 18' long. Invincible style gates over 18' long shall have pickets face-welded to 2" x 2" angle iron to form panels equal in length to the gate frame bay width.
- E. The manufactured roll gates and bolt-on panels (if applicable) shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pre-treatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.
  - 1. Color: Architect to select from manufacturer's full range.
- F. Completed gates shall be capable of supporting a 200 lb. load applied at midspan without permanent deformation.

Table 1 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install fences and gates in accordance with approved shop drawings. Do not begin installation and erection before final grading is established.

- B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
  - 1. If not indicated on Drawings, excavate holes for each post 6 to 8 inches in diameter.
  - 2. Unless otherwise indicated, excavate hole depths not less than 36 inches below the finish grade surface.
  
- C. Setting Posts in Earth: Center and align posts in holes, space as required by manufacturer. Brace terminal post against structure as required.
  - 1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
    - a. Unless otherwise indicated, set top of concrete footings 4 inches below finish grade.
  
- D. Setting Posts in Stone or Existing Concrete:
  - 1. Core drill 3-1/2 inch diameter holes 9 inches deep.
  - 2. Clean holes of loose material, insert posts, and fill space around post with exterior erosion-resistant anchoring cement, mixed and placed to comply with manufacturer's written instructions.
  - 3. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8 inch buildup, sloped away from post.
  
- E. Fence Assembly: Install fully assembled fence sections as indicated on Drawings. Set bottom rail of fence 3 inches above finish grade unless indicated otherwise.

**3.2 CLEANING AND PROTECTION**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
  
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

**PART 4 - TABLES**

<b>Table 1 – Minimum Sizes for Montage II Posts</b>			
<u>Fence Posts</u>	<u>Panel Height</u>		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
<u>Gate Leaf</u>	<u>Gate Height</u>		
	<u>Up to &amp; Including 4'</u>	<u>Over 4' Up to &amp; Including 6'</u>	<u>Over 6' Up to &amp; Including 8'</u>
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

<b>Table 2 – Coating Performance Requirements</b>		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).

Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

<b>Table 3 – Montage II – Post Spacing By Bracket Type</b>										
Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.										

**END OF SECTION 32 31 19**

## **SECTION 32 91 13.13 - TOPSOIL PLACEMENT AND GRADING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting in areas other than designated athletic fields.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for topsoil is on a cubic yard basis.
  - 2. Payment for grading shall be incidental to the project unless included on the bid form.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

### **PART 2 PRODUCTS**

#### **2.1 TOPSOIL**

- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:
  - 1. pH value of between 5.5 and 6.5
  - 2. Liquid limit: 50 or less
  - 3. Plasticity index: 20 or less
  - 4. Gradation: maximum of 10 percent passing No. 200 sieve
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.
- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Owner's Representative.
- B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

#### **3.2 TOPSOIL EXCAVATION**

- A. Conform to excavation and stockpiling requirements of Division 31.

### **3.3 PLACEMENT**

- A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.
- B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Division 31.
- C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.
- D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Division 1.
- E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

### **3.4 PROTECTION**

- A. Protect topsoil from wind and water erosion until planting is completed.

**END OF SECTION 32 91 13.13**

## **SECTION 33 05 13 – MANHOLES AND STRUCTURES**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Precast concrete manholes for sanitary sewers, storm sewers, and water lines.
- B. Precast concrete sanitary sewer manholes with PVC liner where corrosion resistant manholes.
- C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices
  - 1. Payment for normal depth manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Manhole depth is measured from top of cover to sewer invert. Air release manhole depth is measured from top of cover to inside base for air release or vacuum release manholes.
  - 2. Payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 5 feet or less measured from top of cover to sewer invert.
  - 3. Payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Sewer manhole depth is measured from top of cover to sewer invert.
  - 4. No separate payment for internal or external manhole drops.
  - 5. Payment for pile-supported concrete foundation used for unstable subgrade treatment for manhole base is on a unit price basis for each foundation installed.
  - 6. Refer to the provisions of Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASME B 16.1 -Cast Iron Pipe Flanges and Flanged Fittings
- B. ASTM A 307 -Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
- C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. ASTM C 270-Standard Specification for Mortar for Unit Masonry
- E. ASTM C 443 -Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- F. ASTM C 478 -Standard Specification for Precast Reinforced Concrete Manhole Sections
- G. ASTM C 923 -Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
- H. ASTM C 1107 -Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

- I. ASTM D 698 -Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/fr')
- J. ASTM D 2665 -Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- K. ASTM D 2996 -Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- L. ASTM D 2997 -Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
- M. AWWA C 213 -Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
- N. American Association of State Highway and Transportation Officials (AASHTO)

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's data and details of following items for approval:
  - 1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
  - 2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
  - 3. Frames, grates, rings, and covers
  - 4. Materials to be used in fabricating drop connections
  - 5. Materials to be used for pipe connections at manhole walls
  - 6. Materials to be used for stubs and stub plugs, if required
  - 7. Materials and procedures for corrosion-resistant liner and coatings, if required.
  - 8. Plugs to be used for sanitary sewer hydrostatic testing
  - 9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches
- C. Seal submittal drawings by Professional Engineer registered in State of Texas.

### **PART 2 PRODUCTS**

#### **2.1 PRECAST CONCRETE MANHOLES**

- A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading

conditions in Paragraph 2.01 E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.

- C. Provide tops to support HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.
- D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Owner's Representative.
- E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.
  - 1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
  - 2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
  - 3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf
  - 4. Intermalliquid pressure based on unit weight of 63 pcf
  - 5. Dead load of manhole sections fully supported by transition and base slabs
- F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:
  - 1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
  - 2. Wall loading conditions:
    - a. Saturated soil pressure acting on empty manhole
    - b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure
  - 3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater
- G. Provide joints between sections with o-ring gaskets conforming to ASTM C 443.
- H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.
- I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

## 2.2 CONCRETE

- A. Conform to requirements of Division 32.
- B. Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.
- C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, as shown on Drawings, conforming to requirements of Division 31.



- D. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

### **2.3 REINFORCING STEEL**

- A. Conform to requirements of Division 32.

### **2.4 MORTAR**

- A. Conform to requirements of City of Houston Standard Specifications Section 04061 – Mortar.

### **2.5 MISCELLANEOUS METALS**

- A. Provide cast-iron frames, rings, and covers conforming to requirements of Division 33.

### **2.6 DROP CONNECTIONS AND STUBS**

- A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

### **2.7 PIPE CONNECTIONS TO MANHOLE**

- A. Sanitary Sewers.
  - 1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:
    - a. External clamps: Type 304 stainless steel
    - b. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
    - c. Internal, expandable clamps on corrosion-resistant manholes:
      - 1) Type 316 stainless steel, 11 gauge minimum
      - 2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213
  - 2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equal.
- B. Storm Sewer Connections:
  - 1. Provide watertight connections in accordance with ASTM C 923.
- C. Water Lines
  - 1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equal. See Drawings for placement of assembly in manhole sections.
  - 2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

## **2.8 SEALANT MATERIALS**

- A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.
- B. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.
- C. Provide Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

## **2.9 CORROSION RESISTANT MANHOLE MATERIALS**

- A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on Drawings, provide one of following:
  - 1. PVC liner for precast cylindrical manhole section, base sections, and cone sections in accordance with Division 33.
  - 2. Precast base sections, as specified above, lined with PVC or equal and fiberglass manholes in accordance with Division 33.

## **2.10 BACKFILL MATERIALS**

- A. Conform to requirements of Division 31.

## **2.11 NON-SHRINK GROUT**

- A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.
- B. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

## **2.12 VENT PIPES**

- A. Provide external vent pipes for manholes where indicated on Drawings.
- B. Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.
- C. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:
  - 1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
  - 2. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive
  - 3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.
  - 4. Coating: Provide approved 2-component, aliphatic polyurethane coating using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Color shall be selected by The Engineer from manufacturer's standard colors.

### **2.13 PROHIBITED MATERIALS**

- A. Do not use brick masonry for construction of manholes, including adjustment of manholes to grade unless approved by the Engineer. Use only specified materials listed above.

### **2.14 MANHOLE LADDER FOR WATERLINE MANHOLES**

- A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings.
  - 1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
  - 2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.
  - 3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.
  - 4. Provide approved petroleum-based tape encapsulating bolts in access manhole.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that lines and grades are correct.
- B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treat as unstable subgrade.
- C. Do not build manholes in ditches, swales, or drainage paths unless approved by the Engineer.

### **3.2 PLACEMENT**

- A. Install precast manholes to conform to locations and dimensions shown on Drawings.
- B. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

### **3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS**

- A. Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, cement stabilized sand, or concrete foundation slab. Compact cement-sand in accordance with requirements of Division 2.
- B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify the Engineer for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24 inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

### **3.4 PRECAST MANHOLE SECTIONS**

- A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.
- B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.
- D. Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.
- E. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

### **3.5 PIPE CONNECTIONS AT MANHOLES**

- A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.
  - 1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.
  - 2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.
- B. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.
- C. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.
- D. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.
- E. Test connection for watertight seal before backfilling.

### **3.6 INVERTS FOR SANITARY SEWERS**

- A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:
  - 1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum

2. Depth of bench to invert:
    - a. Pipes smaller than 15 inches: one-half of largest pipe diameter
    - b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
    - c. Pipes larger than 24 inches: equal to largest pipe diameter
  3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.
- B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

### **3.7 DROP CONNECTIONS FOR SANITARY SEWERS**

- A. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of four (4) inches outside bells.
- B. Install drop connection when sewer line enters manhole higher than 30 inches above invert of manhole.

### **3.8 STUBS FOR FUTURE CONNECTIONS**

- A. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

### **3.9 MANHOLE FRAME AND ADJUSTMENT RINGS**

- A. Combine precast concrete adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.
- B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.
- C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

### **3.10 BACKFILL**

- A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Division 31. Provide embedment zone backfill material, as specified for adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.
- B. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to springline of pipe with Class B concrete or flowable fill.

- C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32. When shown on Drawings, sod disturbed areas in accordance with Division 32.

**3.11 FIELD QUALITY CONTROL**

- A. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Division 33.

**3.12 PROTECTION**

- A. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to the Owner.

**END OF SECTION 33 05 13**

## **SECTION 33 05 13.13 – MANHOLES GRADE ADJUSTMENT**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Adjusting elevation of manholes, inlets, and valve boxes to new grades.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for adjusting inlets and valve boxes to grade for new construction under this Section. Include payment in unit price for related item.
  - 2. Payment for adjusting existing manhole and frame and cover to new grade is on a unit price basis for each manhole and frame and cover.
  - 3. Payment for adjusting existing utility structures to grade is on unit price basis for each:
    - a. Inlet adjusted
    - b. Valve box adjusted
    - c. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

### **PART 2 PRODUCTS**

#### **2.1 CONCRETE MATERIALS**

- A. Provide concrete, conforming to requirements of Division 33.
- B. Provide precast concrete manhole sections and adjustment rings conforming to requirements of Division 33.
- C. Provide mortar conforming to requirements of City of Houston Standard Specifications Section 04016 - Mortar.

#### **2.2 CAST-IRON MATERIALS**

- A. Provide cast-iron materials conforming to requirements of Division 33.

#### **2.3 PIPING MATERIALS**

- A. For riser pipes and fittings, refer to Division 33.

#### **2.4 MASONRY MATERIALS FOR STORM SEWER MANHOLES AND INLETS**

- A. Provide brick masonry units conforming to the requirements of Division 32.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Project Manger.

#### **3.2 ESTABLISHING GRADE**

- A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

#### **3.3 ADJUSTING MANHOLES AND INLETS**

- A. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in Division 33.
- B. Salvage and reuse cast-iron frame and cover or grate.
- C. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.
- D. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Project Manger's approval.

#### **3.4 ADJUSTING VALVE BOXES**

- A. Salvage and reuse valve box and surrounding concrete block as approved by Project Manger. No separate pay.
- B. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.
- C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.
- D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade.

#### **3.5 BACKFILL AND GRADING**

- A. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Division 31.
- B. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.
- C. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32.

**END OF SECTION 33 05 13.13**



## **SECTION 33 05 16.13 - PRECAST CONCRETE UTILITY STRUCTURES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Precast concrete inlets for storm or sanitary sewers, including cast iron frame and plate or grate.
- B. Precast concrete headwalls and wingwalls for storm sewers.
- C. Precast junction box with lid or grate top.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for precast concrete utility structure is on a unit price basis for each structure installed.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit shop drawings for approval of design and construction details for precast concrete inlets, junction box headwalls, and wingwalls. Precast units differing from standard designs shown on Drawings will be rejected unless shop drawing submittals are approved. Clearly show proposed substitution is equal or superior in every aspect to standard designs.
- C. Submit manufacturers' data and details for frames, grates, rings, and covers.

#### **1.5 STORAGE AND SHIPMENT**

- A. Store precast units on level blocking. Do not place loads until design strength is reached. Shipment of acceptable units may be made when 28-day strength requirements have been met.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Concrete: Provide concrete for precast machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4,000 psi.

- B. Reinforcing Steel: Place reinforcing steel to conform to details shown on Drawings and as follows:
  - 1. Provide positive means for holding steel cages in place throughout production of concrete units. Maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch, whichever is less. Regardless of variation, maintain minimum cover of concrete over reinforcement as shown on Drawings.
  - 2. Welding of reinforcing steel is not permitted unless noted on Drawings.
- C. Mortar and Hydraulic Cement: Conform to requirements of Division 32.
- D. Miscellaneous Metal: Cast-iron frames and plates conforming to requirements of Division 33.

## 2.2 SOURCE QUALITY CONTROL

- A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on Drawings. Concrete thickness in excess of that required will not constitute cause for rejection provided that excess thickness does not interfere with proper jointing operations.
- B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on inside of inlet, headwall, or wingwall.
- C. Rejection: Precast units rejected for non-conformity with these specifications and for following reasons:
  - 1. Fractures or cracks passing through shell, except for single end crack that does not exceed depth of joint.
  - 2. Surface defects indicating honeycombed or open texture.
  - 3. Damaged or misshaped ends, where damage would prevent making satisfactory joint.
- D. Replacement: Immediately remove rejected units from Work site and replace with acceptable units.
- E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in opinion of Owner's Representative, repaired units conform to requirements of these specifications.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify lines and grades are correct.
- B. Verify compacted subgrade will support loads imposed by inlets.

### 3.2 INSTALLATION

- A. Install units complete in place to dimensions, lines, and grades as shown on Drawings.
- B. Excavate in accordance with requirements of Division 31.
- C. Bed precast concrete units on foundations of firm, stable material shaped to conform to shape of unit bases.

- D. Provide adequate means to lift and place concrete units.

### **3.3 FINISHES**

- A. Use hydraulic cement to seal joints, fill lifting holes and as otherwise required.
- B. When box section of inlet has been completed, shape floor of inlet with mortar to conform to Drawing details.
- C. Adjust cast iron inlet plate frames to line, grade, and slope shown on Drawings. Grout frame in place with mortar.

### **3.4 INLET WATERTIGHTNESS**

- A. Verify that inlets are free of leaks. Repair leaks in approved manner.

### **3.5 CONNECTIONS**

- A. Connect storm sewer leads to inlets as shown on Drawings. Seal connections inside and outside with hydraulic cement. Make connections watertight.

### **3.6 BACKFILL**

- A. Backfill area of excavation surrounding each completed inlet, headwall, or wingwall according to requirements of Division 31.

**END OF SECTION 33 05 16.13**

## **SECTION 33 05 16.16 - CONCRETE FOR UTILITY CONSTRUCTION**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No payment will be made for concrete for utility construction under this Section unless specifically noted in bid documents. Include cost in, unit price for appropriate Work item.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 309R - Guide for Consolidation of Concrete.
- G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.
- H. ACI 315 - Details and Detailing of Concrete Reinforcement.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.
- J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.
- K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

- O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
- Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
- R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- S. ASTM C 33 - Standard Specification for Concrete Aggregates.
- T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
- X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- Y. ASTM C 150 - Standard Specification for Portland Cement.
- Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
- BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- FF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
- GG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- HH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- II. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
- JJ. CRSI MSP-1 - Manual of Standard Practice.
- KK. CRSI - Placing Reinforcing Bars.

LL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

MM. NRMCA - Concrete Plant Standards.

#### 1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work.
- C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.
- D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Owner's Representative.
- E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.
- F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.
- G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

#### 1.5 HANDLING AND STORAGE

- A. Cement: Store cement off of ground in well-ventilated, weatherproof building.
- B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.
- C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

### PART 2 PRODUCTS

#### 2.1 CONCRETE MATERIALS

- A. Cementitious Material:
  - 1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Owner's Representative; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.
  - 2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of  $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$ .
- B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.
- C. Fiber:
  - 1. Fibrillated Polypropylene Fiber:
    - a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.

- b. Physical Properties:
  - 1) Material: Polypropylene
  - 2) Length: 1/2 inch or graded
  - 3) Specific Gravity: 0.91
- c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
- 2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.
  - a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
  - b. Physical Properties:
    - 1) Material: Steel
    - 2) Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1
    - 3) Specific Gravity: 7.8
    - 4) Tensile Strength: 40-400 ksi.
    - 5) Young's Modulus: 29,000 ksi
    - 6) Minimum Average Tensile Strength: 50,000 psi
    - 7) Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking
- D. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

## 2.2 FORM WORK MATERIALS

- A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.
- B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.
- C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.
- D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.
- E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

## 2.3 PRODUCTION METHODS

- A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

**2.4 MEASUREMENT OF MATERIALS**

- A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.
- B. Measure water and liquid admixtures by volume.

**2.5 DESIGN MIX**

- A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.
- B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Owner’s Representative for review.
- C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Owner’s Representative.

D. Classification:

Class	Type	Minimum Compressive Strength (LBS/Sq.In.)		Maximum W/C Ratio	Air Content (Percent)	Consistency Range in Slump (Inches)
		7-Day	28-Day			
A	Structural	3200	4000	0.45	4 ± 1	2 to 4*
B	Pipe Block Fill, Thrust Block	---	1500	---	4 ± 1	5 to 7

\*When ASTM C 494, Types F or Type G admixture is used to increase workability, this range may be 6 to 9.

- E. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.
- F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.
- G. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

**2.6 PVC WATERSTOPS**

- A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops:
  - 1. Thickness: not less than 3/8 inch



2. Acceptable Manufacturers:
  - a. Kirkhill Rubber Co., Brea, California
  - b. Water Seals, Inc., Chicago, Illinois
  - c. Progress Unlimited, Inc., New York, New York
  - d. Greenstreak Plastic Products Co., St. Louis, Missouri
  - e. Approved equal.

## 2.7 RESILIENT WATERSTOP

- A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.
- B. Bentonite Waterstop:
  1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
  2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
  3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch
  4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
  1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
  2. Meets or exceeds requirements of Federal Specification SS-S-210A.
  3. Supplied wrapped completely by 2 part protective paper.
  4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.
  5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.
  6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko-Flex Products, Inc.; or approved equal.

## PART 3 EXECUTION

### 3.1 FORMS AND SHORING

- A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.
- B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.
- C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.
- D. Back form work with sufficient number of studs and wales to prevent deflection.

- E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.
- F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).
- G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.
- H. Treat facing of forms with approved form coating before concrete is placed. When directed by Owner's Representative, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

### **3.2 EMBEDDED ITEMS**

- A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.
- B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

### **3.3 BATCHING, MIXING AND DELIVERY OF CONCRETE**

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.
- B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Owner's Representative before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.
- E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed with shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.
- F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- G. Hand-mix only when approved by Owner's Representative.

### **3.4 PLACING CONCRETE**

- A. Give sufficient advance notice to Owner's Representative (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded

items and other preparations for placing concrete. Place no concrete prior to Owner's Representative's approval.

- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.
- C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.
- D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.
- E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.
- F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.
- G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.
- H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

### **3.5 WATERSTOPS**

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.
- B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed en temperature is 35 degrees waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

### **3.6 F and rising. Take temperature readings in**

- A. Splicing PVC Waterstops:
  - 1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.
  - 2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.

3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Owner's Representative, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight-run portions of waterstop in forms.
- B. Setting PVC Waterstops:
1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
  2. Where waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.
- C. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.
- D. Resilient Waterstop:
1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
  2. When requested by Owner's Representative, provide technical assistance by manufacturer's representative in field at no additional cost to City.
  3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
  4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.
  5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.
  6. Bentonite Waterstop:
    - a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
    - b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
    - c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.
    - d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

- e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.
7. Adhesive Waterstop:
  - a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.
  - b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.
  - c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.
  - d. Do not remove protective paper until just before final form work completion. Place concrete immediately. Time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

### 3.7 CONSTRUCTION JOINTS

#### A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Owner's Representative. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.
3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

### 3.8 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Owner's Representative.
- B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.
- C. Rubbed Finish:
  1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
  2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.

- D. Unformed Surfaces: Cure by membrane curing compound method.
1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Owner's Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.
  2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
  3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

### **3.9 REMOVAL OF FORMS AND SHORING**

- A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.
- B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Owner's Representative.

### **3.10 DEFECTIVE WORK**

- A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace entire section.

### **3.11 FINISHING**

- A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.
- B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat and uniform-appearing finish.
- C. Apply wood float finish to concrete slabs.

### **3.12 FIELD QUALITY CONTROL**

- A. Testing shall be performed under provisions of Division 1.
- B. Unless otherwise directed by Owner's Representative, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency, and conform to requirements of ASTM C 1077.
  - 1. Take concrete samples in accordance with ASTM C 172.
  - 2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.
  - 3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
  - 4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.
- C. Test Cores: Conform to ASTM C 42.
- D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.
- E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by Owner's Representative, at no additional cost to City.

### **3.13 PROTECTION**

- A. Protect concrete against damage until final acceptance by City and/or County.
- B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Owner's Representative.

**END OF SECTION 33 05 16.16**

## **SECTION 33 06 10.14 - POLYVINYL CHLORIDE (PVC) PIPE**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.
- B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.
- C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No separate payment will be made for PVC pipe under this section. Include cost in unit price for work included as specified in the following sections:
    - a. Section 33 11 00 – Water Utility Distribution Piping
    - b. Section 33 31 00 – Sanitary Utility Sewerage Piping
    - c. Section 33 31 00.11 – Sanitary Sewage Force Mains
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
- B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
- C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- D. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- F. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
- G. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- H. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- I. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.



- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- L. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- N. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
- O. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.
- P. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- Q. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
- R. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.
- S. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.
- T. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

#### **1.5 QUALITY CONTROL**

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.
- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory

located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Owner's Representative for review. Cost of testing paid by Contractor.

## **PART 2 PRODUCTS**

### **2.1 MATERIAL**

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.
- C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.
  - 1. Pipe Material:
    - a. DR 18: For restrained joints where shown on Drawings.
    - b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.
- D. Water Service.
  - 1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
  - 2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).
- E. Gaskets:
  - 1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
  - 2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
  - 3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.
- F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.
- G. Do not use PVC in potentially or known contaminated areas.
- H. Do not use PVC in areas exposed to direct sunlight.

### **2.2 WATER SERVICE PIPE**

- A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

- B. Pipe 14 inch through 20 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.
- C. Provide Polyvinyl Chloride Pipe from approved manufacturers.
- D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Owner's Representative.
- E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

**2.3 GRAVITY SEWER PIPE**

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

Wall Construction	Manufacturer	ASTM Designation	SDR (Max.)/ Stiffness (Min.)	Diameter Size Range
Solid	J-M Pipe	D3034	SDR 26 / PS 115	6" to 10"
	Certain Teed	D3034	SDR 35 / PS 46	12" & 15"
	Diamond	F679	SDR 35 / PS 46	18" to 27"
	Uponor ETI	AWWA C900	DR 18 / N/A	4" to 12"
	North American	AWWA C909	DR 18 / N/A	4" to 12"
		AWWAC905	DR 18 / N/A	14" to 16"
Truss (Gasketed)	Contech	D2680	N/A / 200 psi	8" to 15"
Profile	Contech A-2000	F949	N/A / 46 psi	12" to 36"
	Contech A-2026	F949	N/A / 115 psi	8" to 10"
	ETI, Ultra-Rib	F794	N/A / 46 psi	8" to 30"
	ETI, Ultra-Corr	F794	N/A / 46 psi	24" to 36"

- B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- C. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- F. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than

40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

- G. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length.
- H. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

#### **2.4 SANITARY SEWER FORCE MAIN PIPE**

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Division 33.
- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings: Provide approved ductile iron fittings as per Division 33, except furnish fittings with one of following approved internal linings:
  - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
  - 2. Nominal 40 mils (35 mils minimum) polyurethane
  - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy
  - 4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Division 33.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

#### **2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE**

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 200 psi, may be provided for up to 12 inches in diameter (water or sanitary).

- B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

### **PART 3 EXECUTION**

#### **3.1 PROTECTION**

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

#### **3.2 INSTALLATION**

- A. Conform to requirements of Division 33, as applicable.
- B. Install PVC pipe in accordance with Division 33, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.
- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
  - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
  - 2. Water service pipe 16 inches in diameter and larger 5 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.
- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

#### **3.3 PVC RESTRAINED MECHANISM**

- A. Do not apply lubricant to spline or pipe or coupling spline grooves.
- B. Do not use excessive force while inserting the spline through coupling.
- C. Insert spline until it is fully seated around circumference of pipe.
- D. Field Cutting of Pipe Ends:
  - 1. Perform by workers certified by manufacturer.
  - 2. Use a PVC pipe cutter and provide square ends.
  - 3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

**END OF SECTION 33 06 10.14**

## **SECTION 33 06 40.10 - HDPE SOLID AND PROFILE WALL PIPE**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.
- B. High density polyethylene (HDPE) pipe for sanitary sewer force mains, including fittings.
- C. High density polyethylene (HDPE) pipe for storm sewers culverts.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for work, as specified in Division 33.
  - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Drainage Pipe, 18"-48" diameter.
- B. AASHTO Section 18 - Soil Thermoplastic Pipe Interaction Systems.
- C. AASHTO Section 30 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.
- D. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.
- E. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- F. ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.
- G. ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.
- H. ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
- I. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- L. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

- M. ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.
- N. ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

- A. Provide manufacturer's certificate of conformance to Specifications.
- B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.
- C. Owner's Representative reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
  - 1. Manufacturer's Notification: Should Owner's Representative wish to witness manufacture of specific pipes, manufacturer shall provide Owner's Representative with minimum three weeks notice of when and where production of those specific pipes will take place.
  - 2. Failure to Inspect. Approval of products or tests is not implied by Owner's Representative's decision not to inspect manufacturing, testing, or finished pipes.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

PART 2 PRODUCTS

2.1 GENERAL

- A. For sanitary sewer pipe provide HDPE pipe as follows:
  - 1. NEW CONSTRUCTION PIPE PRODUCTS GRAVITY SANITARY SEWER DIRECT BURY

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM or AASHTO	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02505	Solid Wall Polyethylene (HDPE)	Chevron Plexco Phillip 66 Quail Poly Pipe	ASTM F-714	DR 17 DR 21	115 46	8" – 10" 12" – 48"
	Polyethylene	Spirolity	ASTM	n/a	46	18"–120"

02531	Profile Wall		F-894			
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2. REHABILITATION CONSTRUCTION PIPE PRODUCTS SLIPLINING OF SANITARY SEWER

INSTALLATION SPEC NO.	GENERIC NAME	TRADE NAME OR MANUFACTURER	ASTM	SDR (NUMERIC MAXIMUM)	PIPE STIFFNESS (NUMERIC MINIMUM)	SIZE RANGE
02550	Solid Wall Poly	Chevron Plexco Quail Poly Pipe AmeriFlow by NAPCO Ameriflow by KWH	F-714	DR 21	46	8" – 48" 3" – 12" 14" – 63"
02550	Polyethylene Profile Wall	Spirolity	F-894	n/a	46	18"–120"

- B. For Storm Sewer and Residential Driveway Culverts provide HDPE as follows:
1. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
  2. Sure-Lok F477 by Hancor, Inc.
- C. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.
- D. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.
- E. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.
- F. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:
1. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged conforming to the requirements of ASTM F-477.
- G. Jointing:
1. Gaskets:
    - a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.



- b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

Contaminant	Gasket Material Required
Petroleum (diesel, gasoline)	Nitrile Rubber
Other contaminants	As recommended by pipe manufacturer

- 2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

**2.2 MATERIALS FOR SANITARY SEWER**

- A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.
- B. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

**2.3 MATERIALS FOR STORM SEWERS AND RESIDENTIAL DRIVEWAY CULVERTS**

- A. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M 294, AASHTO MP7 and ASTM D 3350.
- B. Types: CPP shall meet one or both of following:
  - 1. Type S: Outer corrugated wall with smooth inner liner.
  - 2. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.
- C. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

**2.4 TEST METHODS FOR SANITARY SEWER**

- A. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.

- C. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.
- D. Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

## 2.5 TEST METHODS FOR STOMR SEWERS AND RESIDENTIAL DRIVEWAY CULVERTS

- A. Pipe stiffness at 5 percent deflection, when determined in accordance with ASTM D 2412, shall be as specified in Section 7.4 of AASHTO M 294.
- B. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M 294.

## 2.6 MARKING

- A. Mark each standard and random length of pipe in compliance with these Specifications with following information:
  - 1. Pipe size.
  - 2. Pipe class.
  - 3. Production code.
  - 4. Material designation.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Conform to requirements of Division 33.
- B. Install pipe in accordance with the manufacturers recommended installation procedures.
- C. HDPE pipe is not approved in applications requiring augering of pipe.
- D. Bedding and backfill: Conform to requirements of Division 31.

**END OF SECTION 33 06 40**

## **SECTION 33 06 40.11 - REINFORCED CONCRETE PIPE**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Reinforced concrete pipe for storm sewers.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for work, as specified in the following sections:
    - a. Section 33 41 00 - Storm Utility Drainage Piping.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM C 76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- B. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe.
- C. ASTM C 497 - Method of Testing Concrete Pipe, Sections, or Tile.
- D. ASTM C 506 - Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.
- E. ASTM C 507 - Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
- F. ASTM C 655 - Reinforced Concrete D-load Culvert, Storm Drain and Sewer Pipe.
- G. ASTM C 822 - Standard Definitions and Terms Relating to Concrete Pipe and Related Products.
- H. ASTM C 877 - Standard Specification for External Sealing Bands for Non circular Concrete Sewer, Storm Drain, and Culvert Pipe.

#### **1.4 SUBMITTALS**

- A. Submittals shall conform to requirements in Division 1.
- B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.
- C. Submit certificates by a testing laboratory, hired and paid by the manufacturer, that concrete pipes meet applicable standards when tested in accordance with ASTM C 497.

## **PART 2 P R O D U C T S**

### **2.1 REINFORCED CONCRETE PIPE**

- A. Circular reinforced concrete pipe shall conform to requirements of ASTM C 76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C 443.
- B. Reinforced concrete arch pipe shall conform to the requirements of ASTM C 506 for Class A-III. Joints shall conform to ASTM C 877.
- C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C 877.
- D. Reinforced concrete D-load pipe shall conform to the requirements of ASTM C 655.

### **2.2 GASKETS**

- A. When no contaminant is identified, furnish rubber gasket conforming to ASTM C 443 for circular reinforced concrete pipe and rubber gasket conforming to ASTM C 877 for reinforced concrete elliptical pipe.
- B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants:

<b>CONTAMINANT</b>	<b>GASKET MATERIAL REQUIRED</b>
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by the pipe manufacturer

### **2.3 SOURCE QUALITY CONTROL**

- A. Representatives of Engineer will inspect manufacturer's plant and casting operations as deemed necessary.

## **PART 3 E X E C U T I O N**

### **3.1 INSTALLATION**

- A. Conform to requirements of the following Sections, as applicable:
  - 1. 33 41 00 - Storm Utility Drainage Piping
- B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

**END OF SECTION 33 06 40.11**

## **SECTION 33 11 00 - WATER UTILITY DISTRIBUTION PIPING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Installation of water lines.
- B. Specifications identify requirements for both small diameter water lines and large diameter water lines. When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for water utility distribution piping will be by type and size on a linear foot basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings
- B. ANSI/NSF Standard 61 - Drinking Water System -Health Components
- C. ASTM A 36 - Standard Specification for Carbon Structural Steel
- D. ASTM A 536 - Standard Specification for Ductile Iron Castings
- E. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- F. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes
- G. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
- H. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar
- I. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.
- J. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination
- K. ASTM E 709 - Standard Guide for Magnetic Particle Examination
- L. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe
- M. AWWA C 206 - Standard for Field Welding of Steel Water Pipe
- N. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Conform to submittal requirements of applicable Section for type of pipe used.
- C. Photographs: Submit photographs conforming to requirements of Division 1 prior to commencement of construction.
- D. Submit videotapes conforming to requirements of Division 1, if applicable.
- E. Submit Lone Star notification transmittal number prior to beginning excavation.
- F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:
  - 1. Disinfection; not to exceed 4,000 linear feet per section.
  - 2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
  - 3. Site restoration; not to exceed limits specified; Sequence in order of disturbance.

### **PART 2 PRODUCTS**

#### **2.1 PIPE MATERIALS**

- A. Install pipe materials which conform to Division 33.
- B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
- C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.
- D. Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

#### **2.2 WELDED JOINT PROTECTION FITTING FOR SMALL DIAMETER STEEL PIPE**

- A. Cylindrical Corrosion Barrier: Provide approved cylindrical corrosion barrier.
- B. O-rings: Conform to National Sanitary Foundation requirements.

#### **2.3 RESTRAINED JOINTS**

- A. Ductile-Iron Pipe: See Division 33.
- B. PVC Pipe: See Division 33. Perform hydrostatic testing in accordance with ASTM F 1674.
- C. Prestressed Concrete Cylinder Pipe, Bar-Wrapped Pipe and Steel Pipe: Welded joints (see Paragraph 3.06 D).
- D. Restrained Joints where required on DIP and PVC pipe:

1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.
2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

## **2.4 COUPLINGS AND APPURTENANCES FOR LARGE DIAMETER WATERLINE**

- A. Flexible (Dresser-type) Couplings.
  1. Install where shown on Drawings or where allowed by Owner's Representative for Contractor's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene or Buna-N.
  2. For steel pipe; provide approved sleeve-type flexible couplings. Thickness of middle ring equal to or greater than thickness of pipe wall.
  3. Provide approved flanged adapter couplings for steel pipe.
  4. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of approved coal tar coating.
- B. Flap Valves: Provide approved flap valves on discharge of manhole drainline as shown on Drawings.
  1. Body and Flap: ASTM A 126-B cast iron.
  2. Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.
  3. Resilient Seat
  4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.
  5. Hinge pins: ASTM B 98-CA655 silicon bronze.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Conform to applicable installation specifications for types of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- C. Lay pipe to lines and grades shown on Drawings.
- D. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes or separation of four feet minimum from force mains as specified in this Section in all directions unless special design is provided on Drawings.
- E. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Owner's Representative before proceeding with construction.
- F. Inform Owner's Representative if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Owner's Representative.
- G. For projects involving multiple subdivisions or locations, limit water line installation to maximum of two project site locations. Maximizing 2 pipe installation crews shall be permitted, unless otherwise approved by Owner's Representative.

- H. Only the appropriate governing agency will handle operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.
- I. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.
- J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.
- K. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.
- L. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Owner's Representative.

### 3.2 HANDLING, CLEANING AND INSPECTION

- A. Handling:
  - 1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
  - 2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
  - 3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
  - 4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
  - 5. Use precautions to prevent injury to pipe, protective linings and coatings.
    - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
    - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
    - c. Do not lift pipe using hooks at each end of pipe.
    - d. Do not place debris, tools, clothing, or other materials on pipe.
  - 6. Repair damage to pipe or protective lining and coating before final acceptance.
  - 7. For cement mortar line and coated steel pipe and PCCP, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:
    - a. In surface laitance of centrifugally cast concrete.
    - b. In sections of pipe with steel reinforcing collars or wrappers.
    - c. Within 12 inches of pipe ends.
  - 8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.



- B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

### **3.3 EARTHWORK**

- A. Conform to applicable provisions of Division 31.
- B. Bedding: Use bedding materials in conformance with Division 31.
- C. Backfill: Use bank run sand or earth or native soil as specified in Division 31. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
- D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density Water tamping is not allowed.
- E. Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

### **3.4 PIPE CUTTING**

- A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Owner's Representative. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

### **3.5 PIPING INSTALLATION**

- A. General Requirements:
  - 1. Lay pipe in subgrade free of water.
  - 2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
  - 3. Properly form bedding to fully support bell without wedging or blocking up bell.
  - 4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.
- B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Owner's Representative prior to skipping any portion of Work.
- C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

- D. Perform Critical Location as shown on Drawings. Refer to Division 33 for additional requirements at critical locations.
- E. Laying Large Diameter Water Line
1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
  2. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Owner's Representative. No additional payment will be made for higher class of pipe or improved bedding.
  3. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
  4. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
  5. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.
  6. Prior to proceeding with critical tie-ins submit sequence of work based on findings from "critical location" effort.
- F. Perform following additional procedures when working on plant sites.
1. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with Owner's Representative and Water Production personnel. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until Owner's Representative agrees key personnel, equipment and materials are on hand to complete Work.
  2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
  3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by Owner's Representative and the governing agency is present to observe.
  4. Coordinate with the governing agency to obtain reduction in operating pressures prior to performing connections to existing piping.
  5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Owner's Representative.
  6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Division 1.
  7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.
  8. Submit to Owner's Representative Lone Star Notification transmittal number prior to beginning excavation.
  9. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.
  10. Provide adequate notice to pipe manufacture's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
  11. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Division 1.

12. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to Owner's Representative by noon on Thursday of week. Contact person must be accessible during weekend, have Houston Metro Area phone number, and be authorized to make emergency decisions.
  13. No night work or plant shut down will be scheduled to begin two working days before or after designated Holidays.
- G. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide governing agency a minimum of two weeks notice prior to shutting down existing water line.

### 3.6 JOINTS AND JOINTING

- A. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped Pipe PVC, Steel, and DIP:
1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
  2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
  3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
  4. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.
  5. Where preventing movement of 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
    - a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.
    - b. Do not include passive resistance of soil in thrust restraint calculations.
  6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Owner's Representative.
- B. Flanged Joints where required on Concrete Cylinder Pipe, Bar Wrapped Pipe, Ductile Iron Pipe, or Steel Pipe:
1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal or north-south center line. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
  2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
  3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Densco petroleum based tape or approved equal for all exposed portions of nuts, bolts and pipe.
  4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with City of Houston's "Approved Products List."

5. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrite seal, conforming to ANSI A 21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.
- C. Welded Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):
1. Prior to starting work, provide certification of qualification for welders employed on project for type of work procedures and positions involved.
  2. Joints: AWWA C 206. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
  3. Furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
  4. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1 1/2 inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.
  5. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true, and preserve alignment during welding operation. For butt welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, take care to avoid damage to linings and coatings.
  6. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
  7. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
  8. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
  9. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.
  10. Do not weld under weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
  11. Make tack weld of same material and by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
  12. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
  13. Welded Joints for Large Diameter Water Lines:
    - a. Furnish pipe with trimmed spigots and interior welds for 36-inch and larger pipe.
    - b. Use exterior welds for 30 inch and smaller.
    - c. Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2 1/2 degrees.
    - d. For large diameter water lines, employ an independent certified testing laboratory, approved by Owner's Representative, to perform weld acceptance tests on welded joints. Include cost of such testing and associated work to accommodate testing in contract unit price bid for water line. Furnish copies of test reports to Owner's Representative for review. Owner's Representative has final decision as to suitability of welds tested.
      - 1) Weld acceptance criteria:

- a) Conduct in accordance with ASTM E165- Standard Test Method for Liquid Penetrant Examination and ASTM E709 Standard Guide for Magnetic Particle Examination. Use X-ray methods for butt welds, for 100 percent of joint welds.
  - b) Examine welded surfaces for the following defects:
    - (1) Cracking
    - (2) Lack of fusion/penetration
    - (3) Slag which exceeds one-third (t) where (t) equals material thickness
    - (4) Porosity/Relevant rounded indications greater than 3/16 inch; rounded indication is one of circular or elliptical shape with length equal to or less than three times its width
    - (5) Relevant linear indications in which length of linear indication exceeds three times its width
    - (6) Four or more relevant 1/16-inch rounded indications in line separated by 1/16 inch or less edge
14. After pipe is joined and prior to start of welding procedure, make spigot and bell essentially concentric by jacking, shimming or tacking to obtain clearance tolerance around periphery of joint except for deflected joints.
  15. Furnish each welder employed steel stencil for marking welds, so work of each welder can be identified. Mark pipe with assigned stencil adjacent to weld. When welder leaves job, stencil must be voided and not duplicated. Welder making defective welds must discontinue work and leave project site. Welder may return to project site only after recertification.
  16. Provide cylindrical corrosion barriers for epoxy lined steel pipe 24-inch diameter and smaller, unless minimum wall thickness is 0.5 inches or greater.
    - a. In addition to welding requirements contained here in Paragraph 3.06, conform to protection fitting manufacturer's installation recommendations.
    - b. Provide services of technical representative of manufacturer available on site at beginning of pipe laying operations. Representative to train welders and advise regarding installation and general construction methods. Welders must have 12 months prior experience installing protection fittings.
    - c. All steel pipe is to have cutback 3/4 inch to no greater than 1 inch of internal diameter coating from weld bevel.
    - d. Furnish steel fittings with cylindrical corrosion barriers with shop welded extensions to end of fittings. Extension length to measure no less than diameter of pipe. Shop apply lining in accordance with AWWA C 210 or AWWA C 213.
    - e. All steel pipe receiving field adjustments are to be cold cut using standard practices and equipment. No cutting using torch is to be allowed.
- D. Harnessed Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe):
1. Use of snap-ring type restrained joints on pipe is limited to 20-inch through 48-inch diameters.
  2. Position snap-ring joint bolt on top (12 o'clock portion). Provide minimum 1/2-inch joint recess. Use joint "diapers" minimum of 12 inches wide.
  3. For field adjustments with deflections beyond manufacturer's recommendations:
    - a. Field trim spigot.
    - b. Do not engage ring.
  4. Harnessed joints are not permitted in areas defined on Drawings as potentially petroleum contaminated material, in tunnels, or at bend greater than 5 degrees.
  5. Install harness type joints including snap rings at straight sections of pipe.

E. Restrained Joints

1. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks.
2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of prestressed concrete cylinder pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer in State of Texas for review by Owner's Representative. Make adjustments in thrust restraint lengths at no additional cost to Owner.
3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
4. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
5. Installation.
  - a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
  - b. Examine and clean mechanism; remove dirt, debris and other foreign material.
  - c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
  - d. Verify gasket is evenly seated.
  - e. Do not over stab pipe into mechanism.
6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
7. Place 2500 psi concrete conforming to Division 32, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.

F. Joint Grout (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):

1. Mix cement grout mixture by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Place grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
2. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without rettempering. Use grout for filling grooves of such consistency that it will adhere to ends of pipe.
3. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
4. Follow established procedures for hot and cold weather concrete placement.
5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.

6. Grouting exterior joint space: Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
  7. Interior Joints for Pipe 24 inches and Smaller: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use swab approved by Owner's Representative for 20-inch pipe and smaller.
  8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if joint bands are protected by zinc metallizing or other approved protective coatings.
  9. Remove and replace improperly cured or otherwise defective grout.
  10. Strike off grout on interior joints and make smooth with inside diameter of pipe.
  11. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply approved flexible sealer, such as Flex Protex or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.
  12. Interior Joints for Water Lines 30 inches and Larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe using steel trowel so that surface is smooth. Accomplish grouting at end of each work day. Obtain written acceptance from Owner's Representative of inside joints before proceeding with next day's pipe laying operation. During inspection, insure no delamination of joint mortar has occurred by striking joint mortar lining with rubber mallet. Remove and replace delaminated mortar lining.
  13. Work which requires heavy equipment to be over water line must be completed before mortar is applied to interior joints.
- G. Large Diameter Water Main Joint Testing: In addition to testing individual joints with feeler gauge approximately 1/2 inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. Perform tests at no additional cost to Owner.
- H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Owner's Representative. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.
1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
  2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
  3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
  4. Replace, repair, or reapply coatings and linings as required.

5. Assessment of deflection may be measured by Owner's Representative at location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
  6. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.
- I. Closures Sections and Approved Field Modifications to Steel, Concrete Cylinder Pipe, Bar Wrapped Pipe and Fittings:
1. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.
  2. Fill exposed interior and exterior surfaces with nonshrink grout.
  3. For pipe diameters 36 inches and greater, perform field welds on interior and exterior of pipe.
  4. For large diameter water lines, provide minimum overlap of 4 inches of butt strap over adjacent piece on butt-strap closures.

### 3.7 CATHODIC PROTECTION APPURTENANCES

- A. Where identified on Drawings, modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits including test stations at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water line, access manhole piping and other major openings in water line, or as shown on Drawings.
- B. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint or as shown on Drawings. No additional bonding required where joints are welded for thrust restraint. Repair coating As specified by appropriate AWWA standard, as recommended by manufacturer, and as approved by Owner's Representative.
- C. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

### 3.8 SECURING, SUPPORTING AND ANCHORING

- A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.
- B. Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
- C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.



### **3.9 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE**

- A. Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.
- B. Do not use polyethylene wrap if pipe is cathodically protected.
- C. Conform to requirements of Division 33.

### **3.10 CLEANUP AND RESTORATION**

- A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old water lines, backfill and surface restoration.
- B. Unless otherwise approved by Owner's Representative, comply with the following:
  - 1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.
  - 2. No later than three days after completing disinfection preparatory work, execute disinfection work.
  - 3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
  - 4. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Division 1.
  - 5. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.
- C. For large diameter water lines, do not install more than 2,000 linear feet of water line, without previous 2,000 linear feet being restored in accordance with Division 1. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet. Failure to comply with this requirement shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

### **3.11 CLEANING PIPING SYSTEMS**

- A. Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning. Owner's Representative must inspect water line for cleanliness prior to filling.

### **3.12 DISINFECTION OF WATER LINES**

- A. Conform to requirements of Division 33.

### **3.13 FIELD HYDROSTATIC TESTS**

- A. Conform to requirements of Division 33.

**END OF SECTION 33 11 00**

## **SECTION 33 11 00.10 - AUGERING FOR WATER UTILITY DISTRIBUTION PIPING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Installing water service pipe by methods of augering or casing by jacking and boring.
- B. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) water mains and large-diameter (greater than 20 inches) water mains. When specifications for large-diameter water mains differ from those for small-diameter water mains, paragraphs for large-diameter mains will govern for large-diameter pipe.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices.
  - 1. Measurement and payment for pipe installed shall be at the unit price contained in the bid proposal, for each linear foot of pipe installed, complete in place including furnishing of all materials, all equipment, tools, transportation, services, labor and superintendence necessary for the construction and completion of improvements, including fittings; sheeting, bracing, and supporting the adjacent ground of structure where necessary; handling all drainage or ground water; replacing damaged water and sewer service lines, conduits, ducts, etc.; backfilling the trench and pits; removing surplus excavated materials; sterilizing the completed pipelines; replacing street base and surfaces; and other incidentals required to complete the Work.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

#### **1.3 DEFINITIONS**

- A. Dry Auger Method: Installation of steel casing by excavating soil at the advancing end of casing and transporting spoil through casing by an otherwise uncased auger, while advancing casing by jacking at same rate as auger excavation progresses.
- B. Slurry Auger Method: Installation of casing or pipe by first drilling a small diameter pilot hole from shaft to shaft, followed by reaming the bore to full diameter by augering with slurry, and installing casing or pipe by a pull-back or jacking method.

#### **1.4 REFERENCE STANDARDS**

- A. ASTM D 638 - Test Method for Tensile Properties of Plastics.
- B. ASTM D 648 - Test Method for Deflection Temperature of Plastics Under Flexural Load.
- C. ASTM D 695 - Test Method for Compressive Properties of Rigid Plastics.
- D. ASTM D 790 - Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

## **1.5 REGULATORY REQUIREMENTS**

- A. Conform to Texas State Department of Highways and Public Transportation for installations under state highways. Owner will obtain required permits for State Highway crossings.
- B. Installations Under Railroads:
  - 1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements.
  - 2. Use dry auger method only.
  - 3. No extra compensation for damages due to delays caused by the railroad requesting work to be done at hours which will not inconvenience the railroad.
  - 4. Maintain minimum 35-foot clearance from centerline of tracks.

## **1.6 SUBMITTALS**

- A. Submit product data in accordance with requirements of Section 01 33 00 – Submittal Procedures.
- B. Submit product data for casing insulators for approval.
- C. Prior to commencement of work, furnish for Engineer's approval, a plan showing pit locations, size, depth, and areas for storage, material, and spoil handling. Approval of this plan does not relieve Contractor from responsibility to obtain specified results.
- D. Show actual pit locations dimensioned on as-built drawings so that they can be identified in field.
- E. Submit copy of railroad company permits and rights of entry to Engineer.

## **1.7 CRITERIA FOR SELECTION OF MATERIAL**

- A. Contractor shall be responsible for selection of casing, pipe, and pipe joints to carry anticipated thrust of jacks or loads.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Piping and Fittings: As required by Specification or Drawings.
- B. Casings: Where shown on Drawings, in accordance with Section 33 11 00.10 - Steel Pipe and Fittings.
- C. Casing Spacers: Where casings are shown on Drawings, casing spacer width 8 inches for pipe sizes 4 to 14 inches; 12 inches for pipe sizes 16 to 30 inches.
  - 1. For welded steel pipe 12 inches and smaller, use Pipeline Seal & Insulator Model PE, or approved equal.
  - 2. For other pipe materials, use Pipeline Seal & Insulator Model C8G-2 or approved equal for pipe sizes up to 12 inches.
  - 3. For all pipe sizes above 12 inches, use Pipeline Seal & Insulator Model C12G-2 or approved equal.
- D. Casing End Seals: Provide Pipeline Seal and Insulator Model C, or approved equal.

- E. Casing Spacers (Additional Requirements for Large-Diameter Water Mains): Bolt-on style with shell made of two sections of 14-gauge carbon steel, hot rolled, pickled, and lined with PVC liner, 0.090 inch thick with Durometer A 85-90 overlapping edges to secure liner to spacer; deep embossed flanges for added strength; coated prior to installation of liner and runner with fusion-bonded powder of 14 to 20 mils thickness; electroplated studs, nuts, and washers.
- F. Runners (For Large-Diameter Water Mains): Supported by 10-gauge carbon steel MIG risers welded to shell. Minimum requirements:
  - 1. Tensile Strength: ASTM D 638; 17,600 psi.
  - 2. Flexural Strength: ASTM D 790; 25,300 psi.
  - 3. Compression Strength: ASTM D 695; 18,000 psi.
  - 4. Deflection Temperature at 264 psi: ASTM D 648; 405 F.

### **PART 3 EXECUTION**

#### **3.1 LIMITS ON AUGER LENGTH**

- A. Do not exceed 100 feet for length of auger hole without intermediate pit.
- B. Do not exceed 75 feet for length of auger hole for PVC pipe 12 inches and less in diameter without intermediate pit.
- C. Do not exceed 40 feet for length of auger hole for PVC pipe 14 inches to 24 inches in diameter without intermediate pit.

#### **3.2 PREPARATION**

- A. Conform to applicable provisions of Section 31 06 20.17 – Utility Backfill Materials.
- B. Utility Relocations: Relocate utility lines clear of pit and zone of potential significant settlement or other ground disturbance.
- C. Install casings as required by Drawings, in accordance with this Section.
- D. Install temporary solid plug at open end of water main to prevent contamination.

#### **3.3 TRAFFIC CONTROL**

- A. Conform to applicable provisions of Section 01570 - Traffic Control and Regulation.
- B. Secure right-of-entry for crossing railroad company's easement or right-of-way.
- C. During construction operations, furnish, and maintain barricades and lights to safeguard traffic and pedestrians, until such time as backfill has been completed and removed from site. Provide additional barricades and lights as directed by Engineer.

#### **3.4 PITS**

- A. Construct pits on segments of line and within right-of-way. Locate auger pits where there is minimum interference with traffic or access to property. Do not locate pits close to storm drainage channels, ditches, storm water lines, or culverts. Avoid pit locations near potentially contaminated areas.

- B. Pit Size: Size pits to provide adequate room to meet operational requirements for auger construction as well as any structures indicated on the Drawings. Provide minimum 6-inch space between pipe and walls of bore pit. Maximum allowable width of pit shall be 5 feet. Width of pit at surface shall not be less than at bottom. Maximum allowable length of pit shall be no more than 5 feet longer than one full joint of pipe and shall not exceed 25 feet.
- C. Excavate bore pits to finished grade at least 6 inches lower than grade indicated by stakes.
- D. Backfill in accordance with Section 31 06 20.17 – Utility Backfill Materials.
- E. Auger pits that are excavated and backfilled as part of open-cut water line construction shall be in accordance with Section 31 06 20.17 – Utility Backfill Materials.
- F. The provisions for safety protection against traffic, and accidental or unauthorized entry, as specified in Section 02445 - Tunnel Shafts, shall be followed in applicable situations.
- G. Install sheeting, lining, shoring, and bracing required for protection of the workmen and the public in accordance with Section 01 35 26 - Trench Safety Systems.

### **3.5 AUGERING (BORING)**

- A. Auger from approved pit locations. Excavate for pits and install shoring as outlined above under Paragraph 3.7, Pits. Auger mechanically with use of a pilot hole entire length of crossing and check for line and grade on opposite end of bore from work pit. The large hole is to be no more than 2 inches larger than diameter of bell. Place excavated material outside working pit and dispose of as specified. Use water or other fluids in connection with boring operation only to lubricate cuttings; jetting is not permitted.
- B. In unconsolidated soil formations, a gel-forming colloidal drilling fluid may be used. Fluid is to consist of at least 10 percent of high-grade processed bentonite and shall consolidate cuttings of bit, seal walls of hole, and shall furnish lubrication for subsequent removal of cuttings and installation of pipe.
- C. Depending on the character of the soil encountered during the augering operation, conduct operations without interruption, insofar as practical, to prevent the hole from collapsing or the pipe from seizing up in the hole before the installation is complete.
- D. Allowable variation from line and grade shall be as specified under Paragraph 3.07, Jacking Casing.
- E. Remove and replace any pipe damaged in augering operations.

### **3.6 FILLING ANNULAR SPACE**

- A. For installation of water main, block void space around pipe in augered hole with approximately 12 inches of packed clay or approved equal material to prevent bedding or backfill from entering the void around the pipe in the augered hole when compacted. For pipe diameters 4 inches through 8 inches use minimum 1/2-cubic-foot clay; for pipe diameters 12 inches through 16 inches use minimum 3/4-cubic-foot clay.

### **3.7 JACKING CASING**

- A. Comply with Section 01 35 26 - Trench Safety Systems for all pits, access shafts, end trenches, and other excavations relating to work required by specifications. Dewater as required to provide safe working conditions.

- B. If grade of casing at jacking end is below ground surface, excavate pits or trenches for conducting jacking operations and for placing end joints of casing. Wherever end trenches are cut into sides of embankment or beyond it, sheath securely and brace such work to prevent earth caving.
- C. Make up only one joint at a time in pit or trench prior to jacking.
- D. Do not interfere with operation of railroad, street, highway, or other facility, nor to weaken or damage embankment or structure.
- E. Use heavy-duty jacks sized for forcing casing through embankment. Use appropriate jacking head, usually of timber, and bracing between jacks and jacking head and jacking frame or backstop. Apply jacking pressure uniformly around ring of casing. Set casing to be jacked on guides, properly braced together, to support section of casing and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of casing. Excavate embankment material just ahead of casing and remove material through casing. Force casing through embankment with jacks into excavated auger hole.
- F. Conform excavation for underside of casing to contour and grade of casing, for at least one third of circumference of casing. Provide clearance of not more than 2 inches for upper half of casing. Taper off upper clearance to zero at point where excavation conforms to contour of casing.
- G. The excavation may extend beyond end of casing depending on character of material, but shall not exceed 2 feet in any case. Decrease advance excavation at the direction of the Engineer, if character of material being excavated makes it desirable to keep advance excavation closer to end of casing.
- H. Jack casing from low or downstream end. Lateral or vertical variation in final position of casing from line and grade as shown on Drawings will be permitted only to extent of 1 inch in 10 feet, provided such variation is regular and only in one direction and that final grade of flow line is in direction indicated on Drawings.
- I. Use cutting edge of steel plate around head end of casing extending short distance beyond end of casing with inside angles or lugs to keep cutting edge from slipping back onto casing.
- J. Once jacking of casing is begun, carry on without interruption, insofar as practicable, to prevent casing from becoming firmly set in embankment.
- K. Remove and replace any casing damaged in jacking operations.
- L. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of casing.
- M. Grout annular space between casing and excavated hole when loss of embankment occurs or when clearance of 2 inches is exceeded.

### **3.8 SPACER INSTALLATION**

- A. There must be no inadvertent metallic contact between casing and carrier pipe. Spacing of spacers should ensure that carrier pipe is adequately supported throughout its length, particularly at ends, to offset settling and possible electrical shorting. Place end spacer within 6 inches of end of casing pipe, regardless of size of casing and carrier pipe or type of spacer used. Spacing between spacers depends largely on load bearing capabilities of pipe coating and flexibility of pipe.

- B. Grade bottom of trench adjacent to each end of casing to provide firm, uniform, and continuous support for carrier pipe. If trench requires some backfill to establish final trench bottom grade, place backfill material in 6-inch lifts and compact to the density of undisturbed soil.
- C. Install casing spacers in accordance with manufacturer's instructions. Take special care to ensure that subcomponents are correctly assembled and evenly tightened, and that no damage occurs during tightening of insulators or carrier pipe insertion.
- D. Seal annulus between carrier pipe and casing with casing end seals at each end of casing.
- E. Insulator Spacing:
  - 1. Spacing shall be as shown on Drawing with maximum distance between spacers to be 10 feet for pipe sizes 4 to 14 inches and 8 feet for pipe sizes 16 to 30 inches.
  - 2. For ductile iron pipe, flanged pipe, or bell-and-spigot pipe, spacers shall be installed within one foot on each side of bell or flange and one in center of joint when 18- to 20-foot-long joints are used.
  - 3. If casing or carrier pipe is angled, bent, or dented, reduce spacing as directed by Engineer.

### **3.9 SETTLEMENT SURVEYING**

- A. Record the ground surface elevation ahead of the augering operation. Record the elevation of each survey point with an accuracy of 0.01 feet. Locate survey points as follows:
  - 1. Railroads. Track subbase at centerline of each track.
  - 2. Pipeline crossings. Directly above and 10 feet before and after the crossing.
- B. Report settlement observations daily to Engineer and continue until any noticeable settlement has stopped. In the case of observed settlement, increase the monitoring points and observation frequency, as requested by Engineer.

### **3.10 CLEANUP**

- A. Conform to applicable provisions of Section 02 41 13.11 – Construction Waste Management and Disposal.

**END OF SECTION 33 11 00.10**

## **SECTION 33 12 13.10 – TAPPING SLEEVES AND VALVES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Tapping sleeves and valves for connections to existing water system.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for tapping sleeves and valves will be on a unit price basis for each tapping sleeve and valve installed.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- B. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- C. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service.
- D. AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.
- E. AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.
- F. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.
- G. AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit results of tapping sleeves NPT test opening.
- C. Submit manufacturer's affidavit as required in Division 1.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

### **PART 2 PRODUCTS**



## 2.1 MATERIALS

- A. Tapping Sleeves:
1. Tapping Sleeve Bodies: AWWA C 110 cast or ductile iron or AWWA C 200 carbon steel in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts with mechanical joint ends.
  2. Branch Outlet of Tapping Sleeve:
    - a. Flanged, machined recess, AWWA C 207, Class D, ANSI 150 pound drilling.
    - b. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
  3. Use cast iron split sleeve where fire service from 6-inch water line is approved.
- B. Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
1. Flange: AWWA C 207, Class D, ANSI 150 pound drilling.
  2. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
  3. Steel sleeves are restricted to use on pipe sizes 6 inches and larger.
  4. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against outside diameter of pipe.
  5. Bolts: AWWA C 500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.
  6. Steel Sleeves Finish: Fusion-bonded epoxy coated to minimum 12 mil thickness.
  7. Finished Epoxy Coat: Free of laminations and blisters; and remain pliant and resistant to impact with non-peel finish.
  8. Provide approved steel tapping sleeves.
  9. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.
  10. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.
- C. Stainless Steel tapping-sleeve bodies and flange may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
1. Flange: ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling.
  2. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
  3. Stainless Steel sleeves are restricted to use on pipe sizes 4 inches and larger.
  4. Body: ASTM A240 Stainless Steel, Type 304.
  5. Bolts: ASTM A193 Stainless Steel, Type 304.
  6. Nuts: ASTM A194 Stainless Steel, Type 304.
  7. Branch Outlet: Heavy Stainless Steel Pipe.
  8. Provide approved stainless steel tapping sleeves.
  9. Do not use stainless steel sleeves for taps greater than 75 percent of pipe diameter.
- D. Tapping Valves: Meet requirements of Division 33 with following exceptions:
1. Inlet Flanges:
    - a. AWWA C 110; Class 125.
    - b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.
  2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
  3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; double disc.
- E. Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Division 33.

## **PART 3 EXECUTION**

### **3.1 APPLICATION**

- A. Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.
- B. Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.
- C. Hydrostatically test installed tapping sleeve to 150 psig for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.
- D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.
- E. Do not use Large End Bell (LEB) increasers with next size tap unless existing pipe is asbestos-cement.

### **3.2 INSTALLATION**

- A. Verify outside diameter of pipe to be tapped prior to ordering sleeve.
- B. Tighten bolts in proper sequence so that undue stress is not placed on pipe.
- C. Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.
- D. Make tap with sharp, shell cutter:
  - 1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
  - 2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.
- E. Withdraw coupon and flush cuttings from newly-made tap.
- F. Wrap:
  - 1. For 12-inch and smaller tap, wrap completed tapping sleeve and valve in accordance with Division 2.
  - 2. For 16-inch and larger tap, apply coal tar epoxy around completed tapping sleeve and valve. The coal tar epoxy shall be applied with minimum of two (2) coats. Each coat of coal tar epoxy shall have minimum dry film thickness of 16 mils.
- G. Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).
- H. Request inspection of installation prior to backfilling.
- I. Backfill in accordance with Division 31.

**END OF SECTION 33 12 13.10**

## **SECTION 33 12 13.12 - WET CONNECTIONS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Wet connections for new water mains and service lines to existing water mains.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for wet connections are on a unit price basis for each wet connection made.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

#### **1.3 REFERENCES**

- A. AWWA C 800 - Underground Service Line Valves and Fittings.

#### **1.4 DEFINITIONS**

- A. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining the isolated sections, and completing the connections.
- B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of a 2-inch service line.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Pipe shall conform to requirements of applicable portions of Division 33 related to piping materials and to water distribution.
- B. Corporation cocks and saddles shall conform to requirements in Division 33.
- C. Valves shall conform to requirements of Section 33 12 16 – Water Utility Distribution Valves.
- D. Brass fittings shall conform to requirements of AWWA C 800.

### **PART 3 EXECUTION**

#### **3.1 CONNECTION OPERATIONS**

- A. Plan wet connections in such manner and at such hours as to least inconvenience public. Notify Engineer at least 48 hours in advance of making connections.
- B. Do not operate valves on mains in use by Owner. Owner Representative will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections.

- C. Conduct connection operations when Owner Representative is at job site. Connection work shall progress without interruption until complete once existing mains have been cut or plugs has been removed for making connections.

**3.02 2-INCH WET CONNECTIONS**

- A. Tap water main. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing main. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

**END OF SECTION 33 12 13.12**

## **SECTION 33 12 16 - WATER UTILITY DISTRIBUTION VALVES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Gate valves.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for water utility distribution valves is on a unit price basis for each valve installed.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.
- C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
- D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.
- E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.
- F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.
- G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.
- H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's product data for proposed valves for approval.
- C. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

#### **1.5 QUALITY CONTROL**

- A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. Direct bury valves and those in subsurface vaults open clockwise; aboveground and plant valves open counterclockwise.
- B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 20-inches and smaller. When type of valve is indicated, no substitute is allowed.
- C. Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends.
- D. Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.
- E. Gate Valves 2 inches in diameter: Iron body, double disc or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating clockwise to open.
- F. Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:
  - 1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
  - 2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
  - 3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
  - 4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
  - 5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
  - 6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
- G. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
- H. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
- I. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

- J. Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:
1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
  2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
  3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
  4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
  5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
  6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
  7. Discs: Cast iron with bronze disc rings securely pinned into machined dovetailed grooves.
  8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.
  9. Provide bypass for valves 24 inches and larger.
  10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
  11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
  12. Stuffing Boxes: Located on top of bonnet and outside gear case.
- K. Gate valves 14 inches to 24 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.
1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
  2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
  3. Ensure wedge is symmetrical and seals equally well with flow in either direction.
  4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
  5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.
  6. Provide high strength bronze stem and nut.
  7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
  8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.
  9. Provide thrust washers to the thrust collar for easy valve operation.
- L. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.

- M. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.
- N. Gate Valves for Tapping Steel Pipe: Provide double disc gate valve. Resilient wedge gate valve shall only be installed in a vertical position.
- O. Provide flanged joints when valve is connected to steel or PCCP.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Earthwork. Conform to applicable provisions of Division 31.
- B. Operation. Do not use valves for throttling without prior approval of manufacturer.

### **3.2 SETTING VALVES AND VALVE BOXES**

- A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.
- B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.
- C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve.
- D. Assemble and brace box in vertical position as indicated on Drawings.

### **3.3 DISINFECTION AND TESTING**

- A. Assist Owner's Representative with disinfection of valves and appurtenances as required by Division 33 and test as required by Division 33.
- B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- D. Repair or replace valves which exceed leakage rate.



**3.4 PAINTING OF VALVES**

- A. Paint valves in vaults, stations, and above ground with approved paint.

**END OF SECTION 33 12 16**

## **SECTION 33 12 40 - VALVE BOXES, METER BOXES, AND METER VAULTS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Valve boxes for water service.
- B. Meter boxes for water service.
- C. Meter vaults for water service.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No separate payment will be made for valve boxes under this Section. Include payment in unit price for Section 02570 - Water Mains.
  - 2. No separate payment will be made for meter boxes under this Section. Include payment in unit price for Section 02512 - Water Tap and Service Line Installation.
  - 3. Payment for meter vaults is on a unit price basis per vault. Payment will be made for each vault installed regardless of depth.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM A 48 - Standard Specification for Gray Iron Castings.
- B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

#### **1.4 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit manufacturers' product data for following items for approval:
  - 1. Each type of valve box and lid.
  - 2. Each type of meter box and cover.
  - 3. Each type of meter vault frame and cover.
- C. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in State of Texas.

- D. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.
- E. Submit manufacturer's certification that plastic meter boxes meet requirements of Paragraph 2.05, Plastic Meter Boxes.

## **PART 2 PRODUCTS**

### **2.1 VALVE BOXES**

- A. Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.
- B. Cast letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.
- C. Unless otherwise specified, uncoated cast iron.
- D. Riser Pipe.
  - 1. Provide 6-inch PVC, Class 150, DR 18, riser pipes in accordance with Division 33 or
  - 2. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Division 33.
  - 3. Provide single section of pipe.
- E. Concrete for valve box placement:
  - 1. For locations in new concrete pavement, provide strength and mix design of new pavement.
  - 2. For other locations, provide concrete for sidewalks conforming to requirements of Division 32.

### **2.2 METER BOXES**

- A. Provide meter boxes as required by the governing authority and as shown on the drawings.

### **2.3 CAST-IRON METER BOXES**

- A. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.
- B. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.
- C. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

## 2.4 CONCRETE METER BOXES

- A. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength, conforming to requirements of Division 32. Construct to dimensions shown on Drawings.
- B. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

## 2.5 PLASTIC METER BOXES

- A. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

ASTM	REQUIREMENT
D 256	Impact Strength = 1/9 ft.-lb./inch (Izod, Notched)
D 256	Impact Strength – 6.4 ft.-lb./inch (Izod, Un-Notched)
D 638	Tensile Strength (2.0 min.) = 3400 psi
D 648	Deflection Temperature = 170 degrees F
D 2240	Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb.
D 790	Flexural Modulus = 90,000 psi

- B. Meter boxes shall meet the following test requirements:
  - 1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
  - 2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.
  - 3. Meter box body, without lid, shall weigh approximately 7 pounds.

## 2.6 METER VAULTS

- A. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or common brick masonry unless a specific type of construction is required by Drawings.
- B. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Division 32 with minimum compressive strength of 4000 psi at 28 days.
- C. Reinforcing steel for meter vaults: Conform to requirements of Division 32.
- D. Grates and Covers: Conform to requirements of Division 33.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Obtain approval from Owner's Representative for location of meter vault.
- B. Verify lines and grade are correct.
- C. Verify compacted subgrade will support loads imposed by vaults.

### 3.2 VALVE BOXES

- A. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.
  - 1. Install with bell on top of valve.
  - 2. Place riser pipe in plumb, vertical position.
- B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.
- C. Set, align, and adjust valve box so that lid is level with final grade.
- D. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Owner, repaint covers black.

### 3.3 METER BOXES

- A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.
- B. Construct concrete meter boxes to dimensions shown on Drawings.
- C. Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults.
- D. Do not locate under paved areas unless approved by Owner's Representative. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

### 3.4 METER VAULTS

- A. Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.
- B. Precast Meter Vaults:
  - 1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Division 31.
  - 2. Seal lifting holes with cement-sand mortar or non-shrink grout.
- C. Meter Vault Floor Slab:
  - 1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.
  - 2. Precast floor slab elements may be used for precast vault construction.
- D. Cast-in-Place Meter Vault Walls:
  - 1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.

2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
3. Set frame for cover in concrete.

### **3.5 FRAME AND COVER FOR METER VAULTS**

- A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:
  1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.
  2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch.

### **3.6 BACKFILL**

- A. Provide bank run sand in accordance with Division 31 and backfill and compact in accordance with Division 31.
- B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1-to-5 slope from top to natural grade.
- C. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

**END OF SECTION 33 12 40**

## **SECTION 33 12 50 - FIRE HYDRANTS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Fire hydrant construction, valves and fittings.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices
  - 1. No separate payment will be made for PVC pipe under this section. Include cost in unit price for related work.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Fire Hydrants:
  - 1. Certified fire hydrants shall conform to the requirements and tests for American Water Works Association (AWWA) Standard C502-80, or latest revision thereof, entitled, AAWWA Standard for Dry-Barrel Fire Hydrants@ as to their design, component materials, construction, manufacture and testing except as modified or supplemented hereinafter.
  - 2. Fire hydrants shall be 5-1/4 inch Mueller Super Centurion 200 with mechanical joint end inlet, or approved equal, as shown on the Drawings.
  - 3. Threads on nozzles and operating nut shall be National (American) Standard Fire Hose Coupling Screw Threads (per NFPA No. 194 and ANSI B26-1925, latest revision).
  - 4. Hydrants shall conform to the standards of the Texas Fire Insurance Commission.
- B. Valves, Fittings, etc.:
  - 1. Valves, fittings, etc., to be used in the completed installation shall be as specified in Section 33 12 16 - Water Utility Distribution Valves.
- C. Nozzles:
  - 1. Each hydrant shall be equipped with two (2) two and one-half inch (2 2") normal inside diameter hose nozzles and one (1) four inch (4") nominal inside diameter pumper nozzle conforming the National (American) Standard Fire Hose Coupling Screw Threads (per NFPA No. 194 and ANSI B26-1925, latest revision).
  - 2. Nozzles shall be securely fastened into the upper barrel by mechanical means, installed by turning counterclockwise, and shall be locked in place with a security device.
  - 3. Nozzle caps shall be furnished complete with rubber or neoprene gaskets and shall be securely attached to the hydrant barrel with chains of not less than one-eighth inch (1/8") diameter.
  - 4. The pumper nozzle shall be so situated as to allow an unobstructed radius of ten (10) inches from the threaded surface of the nozzle thought the path of travel of a wrench or other device used to fasten a hose to the nozzle.

- D. Each hydrant shall be equipped with an effective breakable hydrant barrel feature.
- E. Operating and Hold Down Nuts:
  - 1. The operating and hold down nuts shall be fabricated of stainless steel or of cast or ductile iron with bronze inserts or, in the alternative, a security device will be provided with each hydrant employing a bronze operating nut to protect this feature of each hydrant from malicious mischief or unauthorized removal. Any such security devices shall not require special tools for normal off/on operation of the hydrant.
  - 2. Hold down assemblies shall be fabricated of suitable metallic materials for the service intended.
- F. The inlet shall be a bell end connection designed for connection to a nominal six-inch (6") hub end, push-on, or mechanical joint assembly as specified in the bidding documents.
- G. Shut-off valve shall be of the Acompression type@ design, closing with the pressure, with center stem construction. The shut-off valve opening shall be circular and shall have a diameter of not less than five and one-quarter inches (5-1/4").
- H. The hydrant shall operate to open by turning to the left (counterclockwise).
- I. Valve Mechanism:
  - 1. The valve seat ring shall be constructed of bronze and shall be threaded into a bronze drain ring to provide an all bronzed drainway.
  - 2. The seat ring and main valve assembly shall be such that it can be removed from above ground through the upper barrel by means of a light-weight seat removal wrench.
  - 3. The valve seat facing shall be constructed of molded rubber having a Durometer rating of 90 □ 5, and shall a minimum thickness of one-half inch (2").
  - 4. The valve stem shall be provided with a breakable stem coupling opposite the barrel breakaway feature. Connecting pins and locking devices shall be constructed of bronze or other corrosion-resistant material. The valve stem shall be provided with a bronze sleeve, suitable AO-ring@ seals, and a travel stop.
  - 5. Operating threads and bearing surfaces shall be fully lubricated when opening or closing the main valve and shall be contained in a lubricating reservoir which is sealed at top and bottom.
  - 6. The operating assembly shall be provided with a thrust bearing or lubricated thrust collar to minimize operating torque.
- J. Hydrant Barrel:
  - 1. The lower hydrant barrel shall be fabricated as a single piece, and shall be connected to the upper hydrant barrel by means of a joint coupling that will provide three hundred and sixty degree (360□) rotation of the upper barrel.
  - 2. The bury length shall be as specified and shall be the distance from the bottom of the inlet to the grounded line. The ground line shall be clearly marked on the barrel.
- K. A bronze or corrosion-resistant material lined drain opening shall be provided. Tapping of drain holes is not required. There shall be no springs, toggle joints, or intricate synchronizing mechanisms in proximity to the drain opening(s).
- L. All dynamic seals shall be of AO-ring@ type not requiring adjustment for a watertight seal; shall be of oil-resistant material; and all moving parts in contact with the seal shall be bronze or other corrosion-resistant material. Static seals shall be rubber, asbestos or other approved composition.



- M. The hydrant barrel shall be designed to permit the use of one or more standard extensions, which shall be available from the hydrant manufacturer, in lengths from 6 inches to 60 inches in 6-inch increments.

**2.2 PAINTING AND COATING**

- A. Hydrants shall be shop coated with a suitable primer and finish painted in the following manner:

- 1. The hydrant barrel shall be painted blue using Texstar enamel or approved equal. The hydrant bonnet shall be painted reflective white with glass beads. The cap shall be painted using Texstar enamel or approved equal as follows:

Line Size	Color of Bonnet and Caps
6-inch	Safety Yellow
8-inch	Brilliant White
10-inch and larger	Safety Green

- 2. Surfaces below the bury line shall be coated with coal-tar enamel or asphalt-base bituminous coating material not less than one (1) mil thickness.
- 3. Interior surfaces below the main valve shall be coated with epoxy in conformance with AWWA C-550 (latest revision).

**2.3 TESTING**

- A. Certified fire hydrants shall comply with the performance standards as stated below. Compliance shall be determined through actual testing of each type or style of fire hydrant proposed for certification.

- 1. Hydraulic Performance Standards:
  - a. Provide a discharge of 1,500 gpm or greater from the single pumper nozzle at a maximum permissible head loss of 8 psig for an inlet operating pressure of no more than 35 psig ± 2 psig.
  - b. A certified pressure loss and quantity of flow test shall be conducted by a qualified testing laboratory on production model (five-foot bury length) of the hydrant (same catalog number) proposed for certification. This testing shall be conducted in strict accordance with AWWA standard C-502 (latest revision). A certified test report shall be submitted, and shall contain the following information:
    - 1) The date of test on a fire hydrant with similar hydraulic characteristics.
    - 2) The name, catalog number, place of manufacture, and date of production of the hydrant(s) tested.

- B. Traffic Impact Performance Standards:

- 1. Certified fire hydrants shall be equipped with a breakable barrel feature and breakable valve stem coupling such that vehicular impact will result in a clean break of the barrel and the valve stem at the breakable feature.
- 2. Upon impact, the hydrant shut-off valve will remain closed and tight against leakage.

3. Damage to the hydrant and appurtenances resulting in an estimated cost in excess of the one hundred dollars (\$100) for replacement breakable barrel feature parts or failure of the barrel to cleanly and completely break upon impact shall be cause for rejection of the hydrant.
- C. Traffic Impact Testing:
1. A certified test report shall be provided which outlines the results of a traffic impact test involving standard production models of the fire hydrant with a breakable barrel the same in design to that proposed for certification.
  2. These hydrants shall be installed in strict accordance with the requirements of AWWA Standards C-600 (latest revision), and shall be struck at a point 18 inches  $\pm$  2 inches above the designated ground line.
  3. The proximate point of impact or the hydrant barrel shall be within two inches of the line perpendicular to the base and equidistant from the pumper nozzle and one hose nozzle.
  4. The intent of the traffic impact test will be to fulfill the following impact scenario through a mechanical impact test procedure approved in writing by the Engineer:
    - a. The point of impact on the vehicle front bumper shall be within six inches of a point equidistant for the midpoint of the bumper and the end point.
    - b. Impact velocity shall be 30 mph  $\pm$  5 mph.
    - c. Successive tests shall be conducted to simulate an impact by standard American-made vehicles with net vehicle weights of 3000, 5000, and 10,000 pounds  $\pm$  500 pounds.

### **PART 3 EXECUTION**

#### **3.1 CONSTRUCTION METHODS**

- A. Allowable methods are specified as follows:
1. The setting of fire hydrants shall be performed in conformity with applicable portions of Section 33 11 00 - Water Utility Distribution Piping..
- B. Hydrants shall be placed at the locations shown on the Drawings and in conformity with details thereon, unless otherwise directed by the Owner=s Representative.
- C. Hydrants, valves, and valve boxes shall be set plumb with valve boxes placed directly over the valves after they have been completed.

**END OF SECTION 33 12 50**

## **SECTION 33 13 00 - DISINFECTING OF WATER UTILITY DISTRIBUTION**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Disinfection of potable water utility distribution piping.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No separate payment will be made for disinfection of water utility distribution under this Section. Include cost in unit price of water utility distribution piping being disinfected.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. AWWA C 651 - Standard for Disinfecting Water Mains.

### **PART 2 PRODUCTS -Not Used**

### **PART 3 EXECUTION**

#### **3.1 CONDUCTING DISINFECTION**

- A. Promptly disinfect water lines constructed before tests are conducted on water lines and before water lines are connected to Public water distribution system.
- B. Contractor shall provide water for disinfection at no additional charge to the Owner.
- C. Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations.
- D. Coordinate chlorination operations through Owner's Representative.

#### **3.2 PREPARATION**

- A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines prior to connection to Public water distribution system. Normally, each valved section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.
- B. Use fire hydrants as blow-offs to flush newly constructed water lines 8 inch diameters and above. Where fire hydrants are not available on water lines, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in manner approved by Owner's Representative. Average water velocity when filling pipeline should be less than one foot per second and

shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

- D. Backfill excavations immediately after installation of risers or blow-offs.
- E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.

### **3.3 DISINFECTION BY CONTRACTOR**

- A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:
  - 1. Use not less than 100 parts of chlorine per million parts of water.
  - 2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
  - 3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
  - 4. Open and close valves in lines being sterilized several times during contact period.
  - 5. If chemical compound is used for sterilizing agent, place in pipes as directed by Owner's Representative.

### **3.4 BACTERIOLOGICAL TESTING**

- A. After disinfection and flushing of water lines, bacteriological tests will be performed by the governing agency or testing laboratory in accordance with Division 1. When test results indicate need for additional disinfection of water lines based upon Texas Department of Health requirements, assist Contractor shall provide additional disinfection operations at no additional cost to the Owner.

### **3.5 COMPLETION**

- A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

**END OF SECTION 33 13 00**

## **SECTION 33 13 00.10 - HYDROSTATIC TESTING OF PIPELINES**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Field hydrostatic testing of newly installed water pipelines.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

### **PART 2 PRODUCTS – Not Used**

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Disinfect water system pipelines prior to hydrostatic testing.
- B. Hydrostatically test newly installed water pipelines after disinfection, when required, and before connecting to Public water distribution system.
- C. Water for testing will be charged to Contractor in accordance with applicable Ordinances. Prior to hydrostatic testing, obtain a transient meter from the appropriate governing authority. Contractor shall pay all fees associated with transient meter.
- D. Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.
- E. Conduct hydrostatic tests in presence of Owner's Representative.

#### **3.2 TEST PROCEDURES**

- A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.
- B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.
- C. For small diameter pipelines, expel air and apply minimum test pressure of 125 psi. For large diameter water lines, expel air and apply minimum test pressure of 150 psi.
- D. Begin test by 9:00 a.m. unless otherwise approved by Owner's Representative. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.
- E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

### **3.3 ALLOWABLE LEAKAGE FOR WATERLINES**

- A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.
- B. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.
- C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Owner's Representative for leakage during pressure test may be used to fulfill requirements of this section.

### **3.4 CORRECTION FOR FAILED TESTS**

- A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
- B. Owner's Representative may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Division 33. Pay for water required for additional disinfection and retesting.
- C. Repeat test until satisfactory results are obtained.

### **3.5 COMPLETION**

- A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

**END OF SECTION 33 13 00.10**

## **SECTION 33 31 00 - SANITARY UTILITY SEWERAGE PIPING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Gravity sanitary sewers and appurtenances, including stacks and service connections.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for pipe installation is on a linear foot basis. Measurement will be taken along the center line of the pipe from center line to center line of manholes. Payment will be made for each linear foot installed complete in place including sewer pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, stacks, cleanouts, accessories, and post TV inspection.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Owner.

#### **1.4 QUALITY ASSURANCE**

- A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Division 33.
- B. Regulatory Requirements.
  - 1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
  - 2. Make notification to Owner's Representative when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
  - 3. Lay gravity sewer lines in straight alignment and grade.

#### **1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Inspect pipe and fittings upon arrival of materials at job site.  
**SANITARY UTILITY SEWERAGE PIPING**

- B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.
- C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

## **PART 2 PRODUCTS**

### **2.1 PIPE**

- A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified.
- B. Reinforced concrete pipe is not acceptable.

### **2.2 PIPE MATERIAL SCHEDULE**

- A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in Division 33.
- B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

### **2.3 APPURTENANCES**

- A. Stacks. Conform to requirements of Division 33.
- B. Service Connections. Conform to requirements of Division 33.
- C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

### **2.4 BEDDING, BACKFILL, AND TOPSOIL MATERIAL**

- A. Bedding and Backfill: Conform to requirements of Division 31.
- B. Topsoil: Conform to requirements of Division 32.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Division 1.
- B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights where work is in progress or where traffic is affected by work.



- C. Perform work in accordance with OSHA standards. Employ trench safety system as specified in Division 31 for excavations over 5 feet deep.
- D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency or utility company for repairs or relocations, either temporary or permanent.
- E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Division 2.
- F. Install and operate dewatering and surface water control measures in accordance with Division 1.
- G. Do not allow sand, debris or runoff to enter sewer system.

### **3.2 DIVERSION PUMPING**

- A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.
- B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.
- C. No sewage shall be diverted into area outside of sanitary sewer.
- D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to Texas Natural Resources Conservation Commission and Environmental Protection Agency by Owner's Representative.

### **3.3 EXCAVATION**

- A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.
- B. Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.
- C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Division 31.

### **3.4 PIPE INSTALLATION BY OPEN CUT**

- A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Owner's Representative.

#### **SANITARY UTILITY SEWERAGE PIPING**

- C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.
- E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.
- G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Owner's Representative.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full 18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.
- K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.
- L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

### **3.5 PIPE INSTALLATION OTHER THAN OPEN CUT**

- A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

### **3.6 INSTALLATION OF APPURTENANCES**

- A. Service Connections. Install service connections to conform to requirements of Division 33.
- B. Stacks. Construct stacks to conform to requirements of Division 33.
- C. Construct manholes to conform to requirements of Division 33 as applicable. Install frames, rings, and covers to conform to requirements of Division 33.

### **3.7 INSPECTION AND TESTING**

- A. Visual Inspection: Check pipe alignment in accordance with Division 33.
- B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Division 33.

#### **SANITARY UTILITY SEWERAGE PIPING**

- C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Division 33. Maintain piezometer installed to conform with Division 1 until acceptance testing is completed.

### **3.8 BACKFILL AND SITE CLEANUP**

- A. Backfill and compact soil in accordance with Division 31.
- B. Backfill trench in specified lifts only after pipe installation is approved by Owner's Representative.
- C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Division 32.
- D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and apply hydromulch according to requirements of Division 32.
- E. Provide sodding in areas of residential land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and sod disturbed areas in accordance with Division 32.

### **3.9 POST-INSTALLATION TELEVISION INSPECTION**

- A. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.
- B. Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.
- C. Perform television inspection of gravity sanitary sewers as follows:
  - 1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
  - 2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.

- 3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.
- D. Provide video tapes on CD in a format compatible with Windows Media Player. Two labels are required. Place one label on the case and the other on face of each CD. Permanently label each video tape with following information.

Face of CD

Wastewater File No.: _____ Contractor's Name: _____ Inspection Type: <input type="checkbox"/> Survey <input type="checkbox"/> Pre-Installation <input type="checkbox"/> Post-Installation Tape No.: _____ Date Televised: _____ Date Submitted: _____ Basin No.: _____
---

CD Case

Manhole No. From	Manhole No. To	Pipe Diameter	Pipe Length	Street
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

- E. For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.
- F. Upon completion of video tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

**TELEVISION INSPECTION CODES**

**HEADER INFORMATION**

<b>LOCATION</b>	
A	STREET ROW, HEAVY TRAFFIC
B	STREET ROW, LIGHT TRAFFIC
C	EASEMENT, POOR ACCESS
D	EASEMENT, GOOD ACCESS
E	PARKING LOT, POOR ACCESS
F	PARKIGN LOT, GOOD ACCESS
G	ALLEY, POOR ACCESS
H	ALLEY, GOOD ACCESS
I	OPEN AREA, POOR ACCESS
J	OPEN AREA, GOOD ACCESS

**SURFACE COVER**

A	ASPHALT STREET
B	CONCRETE STREET
C	SHELL STREET
D	SIDEWALK
E	TREES/SHRUBS
F	CLOSE TO FENCE
G	OPEN AREA
H	MOVABLE BUILDING
I	UNMOVABLE BUILDING
J	OVERHEAD UTILITIES
K	WATERWAY OR RAILWAY
L	HIGHWAY OR RUNWAY
M	PIPE ABOVE GROUND

**PIPE TYPE**

ABS	ACRYLONITRILE BUTADIENE STYRENE
BRK	BRICK
CIP	CAST IRON PIPE
CMP	CORRUGATED METAL PIPE
CON	POURED IN PLACE CONCRETE
CPP	CURED IN PLACE PIPE
DIP	DUCTILE IRON PIPE
FRP	FIBERGLASS REINFORCED PIPE
PLP	PLASTIC LINE CONCRETE PIPE
PEP	POLYETHYLENE PIPE
PVC	POLYVINYLCHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
RPM	REINFORCED PLASTIC MORTAR PIPE
RCP	REINFORCED CONCRETE PIPE
URC	UNREINFORCED CONCRETE PIPE
VCP	VITRIFIED CLAY PIPE

**JOINTS**

<b>CODES</b>		<b>DESCRIPTION</b>	<b>USE IN</b>
MJ – MISALIGNED JOINT			
BJ-BROKEN JOINT			
A (3)	RP JT > 90% CLEAR		MJ
B (6)	DRP JT 80 – 90% CLEAR		MJ
C (9)	DRP JT < 80% CLEAR		MJ
D (3)	SHF JT > 90% CLEAR		MJ
E (6)	SHF JT 80 – 90% CLEAR		MJ
F (9)	SHF JT < 80% CLEAR		MJ
G (1)	WD JT 2” – 3”		MJ
H (2)	WD JT 3” – 4”		MJ
I (3)	WD JT > 4”		MJ
J (2)	BRK JT – LIGHT		BJ
K (4)	BRK JT – MEDIUM		BJ
L (6)	BRK JT – HEAVY		BJ
N (0)	VISIBLE GASKET		MJ
O (0)	LEAKING AT JOINT		MJ

**LATERALS (L)**

<b>CODES</b>	<b>DESCRIPTION</b>
A (1)	PRT SER 0” – 1”
B (2)	PRT SER 1” – 2”
C (3)	PRY SER 2” – 3”
D (4)	PRT SER 3” +
E (5)	EFFECTI E – SERVICE CONN.
F (6)	DEAD/UNUSED SERVICE
G (7)	FACTORY SERVICE
H (0)	PLUMBER SERVICE

**ROOTS (R)**

<b>CODES</b>	<b>DESCRIPTION</b>
A (1)	ROOTS - LIGHT
B (2)	ROOTS - MEDIUM
C (3)	ROOTS – HEAVY

**DEBRIS (D)**

<b>CODES</b>	<b>DESCRIPTION</b>
A	DEBRIS - LIGHT
B	DEBRIS - MEDIUM
C	DEBRIS - HEAVY
D	GREASE - LIGHT
E	GREASE - MEDIUM
F	GREASE – HEAVY

**INFLOW/INFILTRATION (I)**

<b>CODES</b>	<b>DESCRIPTION</b>
A (3)	I/I – LIGHT (0-1 GPM)
B (6)	I/I – MEDIUM (1-5 GPM)
C (9)	I/I – HEAVY (> 5 GPM)
D (2)	I/I – SOME EVIDENCE
E (4)	I/I – CONSIDERABLE EVIDENCE
F (6)	I/I – GREAT EVIDENCE
G (0)	I/I – NO EVIDENCE

SANITARY UTILITY SEWERAGE PIPING

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**WEATHER**  
 DRY - WET

**CODE DESCRIPTIONS**

**CRACKS**

RC-RADIAL                      LC-LONGITUDINAL

<b>CODES</b>	<b>DESCRIPTION</b>	<b>USE IN</b>
A (1)	< ½" W, 1' L	CRK
B (2)	< ½" W, 1' - 2' L	CRK
C (3)	< ½" W, >2' L	CRK
D (4)	> ½" W, < 1' L	CRK
E (5)	> ½" W, 1' - 2' L	CRK
F (6)	> ½" W, > 2' L	CRK
G (7)	HOLE IN PIPE - SMALL	
H (8)	PIPE MISSING - < 60°	
I (9)	PIPE MISSING - > 60°	

**ALIGNMENT (A)**

<b>CODES</b>	<b>DESCRIPTION</b>
A	BEGIN ¼ PIPE WATER
B	BEGIN ½ PIPE WATER
C	CAMERA UNDERWATER
D	END CAMERA UNDERWATER
E	END ½ PIPE WATER
F	END ¼ PIPE WATER

**STRUCTURAL**

DS-DETERIORATED; OS-OVALITY; CS COLLAPSED		
<b>CODES</b>	<b>DESCRIPTION</b>	<b>USE IN</b>
A (3)	LINE DET - LIGHT	DS
B (6)	LINE DET - MEDIUM	DS
C (9)	LINE DET - HEAVY	DS
D (3)	OVAL < 5%	OS
E (6)	OVAL > 5% & < 10%	OS
F (9)	OVAL > 10%	OS
G (9)	COLLAPSED	CS
H (0)	PIPE DET - HEAVY	DS
L (0)	PIPE DET - LIGHT	DS
M (0)	PIPE - MEDIUM	DS
N (0)	PIPE DET - NONE	DS
O	LINE DET - NONE	DS
Z (0)	AT MANHOLE NUMBER	CS

**END OF SECTION 33 31 00**

## **SECTION 33 31 00.10 – ACCEPTANCE TESTING FOR SANITARY SEWERS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Acceptance testing of sanitary sewers including:
  - 1. Visual inspection of sewer pipes.
  - 2. Mandrel testing for flexible sewer pipes.
  - 3. Leakage testing of sewer pipes.
  - 4. Leakage testing of manholes.
  - 5. Smoke testing of point repairs.
  - 6. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 REFERENCES**

- A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.
- B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.
- B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.
- C. Maximum allowable leakage for Infiltration or Exfiltration.

1. The total exfiltration, as determined by hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at minimum test head of 2 feet above crown of pipe at upstream manhole or 2 feet above groundwater elevation, whichever is greater.
  2. When pipes are installed more than 2 feet below groundwater level, use infiltration test in lieu of exfiltration test. Total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.
  3. Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.
- D. Perform air testing in accordance with requirements of this Section and Texas Natural Resources Conservation Commission requirements. Refer to Table 33 31 00.10-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test, and Table 33 31 00.10-4, Vacuum Test Time Table, at end of this Section.

### **1.5 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Owner's Representative. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

### **1.6 GRAVITY SANITARY SEWER QUALITY ASSURANCE**

- A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- B. Provide testing reports and video tape of television inspection as directed by Owner's Representative.
- C. Upon completion of tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

### **1.7 SEQUENCING AND SCHEDULING**

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Owner's Representative. Perform testing under observation of Owner's Representative.



## **PART 2 PRODUCTS**

### **2.1 DEFLECTION MANDREL**

- A. Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
- B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.
- C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.
- D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 30 31 00.10-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Owner's Representative.

### **2.2 EXFILTRATION TEST**

- A. Water Meter: Obtain transient water meter from appropriate governmental agency for use when water for testing will be taken from public system. Conform to governmental agency requirements for water meter use.
- B. Test Equipment:
  - 1. Pipe plugs.
  - 2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

### **2.3 INFILTRATION TEST**

- A. Test Equipment:
  - 1. Calibrated 90 degree V-notch weir.
  - 2. Pipe plugs.

### **2.4 LOW PRESSURE AIR TEST**

- A. Minimum Requirement for Equipment:
  - 1. Control panel.
  - 2. Low-pressure air supply connected to control panel.
  - 3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
  - 4. Air hoses from control panel to:
    - a. Air supply.
    - b. Pneumatic plugs.
    - c. Sealed line for pressuring.

- d. Sealed line for monitoring internal pressure.
- B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

## **2.5 GROUND WATER DETERMINATION**

- A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

## **2.6 SMOKE TESTING**

- A. Equipment:
  - 1. Pneumatic plugs.
  - 2. Smoke generator as supplied by Superior Signal Company, or approved equal.
  - 3. Blowers producing 2500 scfm minimum.

# **PART 3 EXECUTION**

## **3.1 PREPARATION**

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.
- B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Division 1.

## **3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS**

- A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

## **3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS**

- A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.
- B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.
- C. Retest repaired or replaced sewer sections.

### 3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.
2. Plug sewer in downstream manhole.
3. Plug incoming pipes in upstream manhole.
4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.
5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 33 31 00.10-1 at end of this Section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.
2. Plug incoming pipes in upstream manhole.
3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
4. Allow water to rise and flow over weir until it stabilizes.
5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 33 31 00.10-1 at end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 33 01 30-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

2. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.
3. For pipe sections less than 36-inch average inside diameter:
  - a. Determine ground water level.
  - b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
  - c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
  - d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 33 31 00.10-2 at end of this Section.
  - e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 33 31 00.10-2 at end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.

F. Retest: Repair and retest any section of pipe which fails to meet requirements.

### 3.5 TEST CRITERIA TABLES

- A. Exfiltration and Infiltration Water Tests: Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of this Section.
- B. Low Pressure Air Test:
  1. Times in Table 33 31 00.10-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Natural Resources and Conservation Commission (TNRCC) Design Criteria 317.2(a)(4)(B).

		$T = 0.0850(D)(K)/(Q)$
Where:	T =	Time for pressure to drop 1.0 pounds per square inch gauge in seconds
	K =	0.000419 DL, but not less than 1.0
	D =	Average inside diameter in inches
	L =	Length of line of same pipe size in feet
	Q =	Rate of loss, 0.0015 ft <sup>3</sup> /min./sq. ft. internal surface

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test.

Notes:

1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

### 3.6 LEAKAGE TESTING FOR MANHOLES

- A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.
- B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace invert to prevent lines from being dislodged when lines entering manhole have not been backfilled.
- C. Vacuum testing:
  - 1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
  - 2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 33 31 00.10-4, Vacuum Test Time Table.
  - 3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.
- D. Perform hydrostatic exfiltration testing as follows:
  - 1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
  - 2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
  - 3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

### **3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS**

- A. Application: Perform smoke test to:
  - 1. Locate points of line failure for point repair.
  - 2. Determine when point repairs are properly made.
  - 3. Determine when service connections have been reconnected to rehabilitated sewer.
  - 4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.
- B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.
- C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to Police and Fire Departments 24 hours prior to actual smoke testing.
- D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.
- E. Smoke Introduction:
  - 1. Operate equipment according to manufacturer's recommendation and as approved by Owner's Representative.

2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
  3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.
- F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Owner's Representative.
- G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

Table 33 31 00.10-1

**WATER TEST ALLOWABLE LEAKAGE**

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	INCH	GALLONS	PIPE SIZE IN INCHES	GALLONS/MINUTE PER 100 FEET
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	13	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

\* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain.

Table 33 31 00.10-2

**ACCEPTANCE TESTING FOR SANITARY SEWERS**

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG															
Pipe Diam (in.)	Min. Time	Length For Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)											
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft	

**ACCEPTANCE TESTING FOR SANITARY SEWERS**

6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:2	11:2	11:2	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	0	0	0	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	14:1	14:1	17:4	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.470	0	0	8	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:4
24	22:40	99	8	17:0	19:1	25:3	56:59	68:23	79:47	91:10	102:3	113:5	125:2	2
27	25:30	88	13.676	0	4	9	72:07	86:33	100:5	115:2	4	8	2	136:4
30	28:20	80	2	19:5	26:1	35:5	89:02	106:5	8	4	129:4	144:1	158:4	6
33	31:10	72	17.308	0	1	4	107:4	1	124:3	142:2	9	4	0	173:0
			9	22:4	34:1	45:3	4	129:1	9	8	160:1	178:0	195:5	5
			21.369	8	1	5	7	150:5	172:2	6	5	3	213:4	
			0	28:5	43:1	57:4	2	0	3	193:5	215:2	237:0	1	
			25.856	1	6	2				5	8	1	258:3	
			5	35:3	53:2	71:1	4						4	
				7	5	4								
				43:0	64.3	86:1	1							
				6	8	1								

Table 33 31 00.10-3  
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

Pipe Diameter (inches)	Minimum Time (seconds)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

Table 33 31 00.10-4  
VACUUM TEST TIME TABLE

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
*	5.0	6.5	8.0

\*Add T times for each additional 2-foot depth.  
(The values listed above have been extrapolated from ASTM C 924-85)

Table 33 31 00.10-5  
 PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average I.D. (Inches)	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass (Class SN 46)	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
	54	54.82	52.079
60	60.38	57.361	

**END OF SECTION 33 31 00.10**



## **SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Payment for storm sewers is on a linear foot basis for each type and size of pipe installed. Measurement will be taken along the center line of the pipe from center line to center line of manholes or from end to end of culverts.
  - 2. No separate payment will be made for earthwork, connections to existing manholes and pipe, accessories, equipment, and execution required or incidental to storm sewer work. Include cost in unit price for sewer pipe.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

#### **1.3 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

#### **1.4 QUALITY ASSURANCE**

- A. The Condition for acceptance shall be watertight storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.
- B. Provide manufacturer's certification to Specifications.

#### **1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's recommendations.
- B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Do not use Materials cracked, gouged, chipped, dented, or otherwise damaged shall not be use materials for installation.
- C. Store pipe and fittings on heavy timbers or platforms to avoid contact with ground.
- D. Unload pipe, fittings, and appurtenances as close as practical to location of installation to avoid unnecessary handling.
- E. Keep interiors of pipe and fittings free of dirt and foreign matter.

- F. Store PVC pipe out of direct sunlight.

## **PART 2 PRODUCTS**

### **2.1 PIPE**

- A. Provide piping materials for storm sewers shall be of sizes and types specified unless otherwise indicated on Drawings.
- B. In diameters where material alternatives are available, provide pipe from single manufacturer for each pipe diameter, unless otherwise approved by Owner's Representative or otherwise shown on Drawings.
- C. Existing pipe that has been removed during construction cannot be reused.

### **2.2 PIPE MATERIAL SCHEDULE**

- A. Storm Sewer Pipe: Use pipe materials that conforming to requirements specified in Division 33 and as shown on the Drawings.
- B. Driveway Culvert Pipe for Streets with Open Ditches: Use pipe materials that conforming to requirements specified Division 33 and as shown on the Drawings.
- C. Provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- D. Pipe materials other than those listed above shall not be used for storm sewers.

### **2.3 BEDDING, BACKFILL, AND TOPSOIL MATERIAL**

- A. Bedding and Backfill Material: Conform to requirements of Division 31.
- B. Topsoil: Conform to requirements of Division 32.
- C. Use cement stabilized sand material for bedding and backfill in the pipe zone for all storm sewers.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affects traffic. Conform to requirements of Division 1.
- B. Provide barricades, flashing warning lights, and signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections while Work is in progress or where traffic is affected by Work.
- C. Immediately notify agency or company owning utility lines which are damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for repairs or relocations, either temporary or permanent.
- D. Remove old pavements and structures, including sidewalks and driveways in accordance with requirements of Division 2.
- E. Install and operate dewatering and surface water control measures in accordance with Division 1.

### 3.2 EXCAVATION

- A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.
- B. Line and Grade. Establish required uniform line and grade trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of Work. Or use of appropriately sized grade boards which are substantially supported.
- C. Trench Excavation. Excavate pipe trenches to level as indicated on Standard Details. Backfill excavation with specified bedding material to level of lower one-third of pipe barrel. Tamp and compact backfill to provide bedding at indicated grade. Form bedding foundation to minimum depth of one-eighth of pipe diameter, but not less than 6 inches.

### 3.3 PIPE INSTALLATION

- A. Install in accordance with pipe manufacturer's recommendations and as specified in this section.
- B. Install pipe only after excavation is completed, bottom of trench is shaped, bedding material is installed, and trench has been approved by Owner's Representative.
- C. Install pipe to line and grade indicated on Drawings. Place pipe so that it has continuous bearing of barrel on bedding material with no voids, and is laid in trench so interior surfaces of pipe follows grades and alignments indicated.
- D. Install pipe with bells of pipe facing upstream of anticipated flow.
- E. Form concentric joint with each section of adjoining pipe to prevent offsets.
- F. Place and drive home newly laid sections with a sling or come-a-long winches to eliminate damage to sections. Unless otherwise approved by Owner's Representative, provide end protection to prevent damage while using back hoes or similar powered equipment to drive home newly laid sections.
- G. Keep interior of pipe clean as installation progresses.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with pipe plug specifically designed to prevent foreign material from entering pipe.
- J. For PVC Pipe:
  - 1. Provide a minimum cover as per manufacturer's requirements from top of pavement to top of pipe, but no less than 2 feet.
  - 2. Accomplish transitions to different material of pipe in a manhole or inlet box. No adapter, coupling for dissimilar pipe, or saddle connections allowed.
  - 3. Provide pipe sections in standard lengths with minimum length of 13 feet. Pipe may be field modified to shorten length no less than 4 feet, unless otherwise approved by Owner's Representative. Field modify pipe per manufacturer's recommendations.
  - 4. No beveling at joint allowed. Cut to be perpendicular to longitudinal axis.
  - 5. Provide gasketed bell and spigot joints installed per manufacturer's recommendations. Gasketed pipe joints; clean and free of debris, show no leakage after installation.

### **3.4 PIPE INSTALLATION OTHER THAN OPEN CUT**

- A. Conform to requirements of Division 33 where required.
- B. Not allowed for plastic sewer pipe.

### **3.5 INSTALLATION OF APPURTENANCES**

- A. Construct manholes to conform to requirements of Division 33. Install frames, grate rings, and covers to conform to requirements of Division 33.
- B. Install PVC pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars.
- C. Install inlets, headwalls, and wingwalls to conform to requirements of Division 33.
- D. Rehabilitate existing manholes to conform to requirements of Division 33. Adjust manhole covers and inlets to grade conforming to requirements of Division 33.
- E. Dimension for Type C and Type E manholes shall be as shown on Drawings.

### **3.6 INSPECTION AND TESTING**

- A. Perform post installation television inspection in accordance with Division 33. Hand held cameras may be used in storm sewers in lieu of requirements Division 33. Clearly stencil distance markings on each joint of pipe to indicate distance from starting manhole when using hand held cameras.

### **3.7 BACKFILL AND SITE CLEANUP**

- A. Backfill trench after pipe installation is inspected and approved by Owner's Representative.
- B. Backfill and compact soil in accordance with Division 31.
- C. Repair and replace removed or damaged pavement and sidewalks as specified in Division 32.
- D. In unpaved areas, grade surface as uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and seed according to requirements of Division 32 as required.

**END OF SECTION 33 41 00**

## **SECTION 33 49 13 - STORM DRAINAGE MANHOLES, FRAMES AND COVERS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.
- B. Ring grates.

#### **1.2 REFERENCES**

- A. AASHTO -American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges
- B. ASTM A 48 -Standard Specification for Gray Iron Castings
- C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. AWS -D 12.1 Welding Reinforcing Steel.

#### **1.3 SUBMITTALS**

- A. Conform to requirements of Division 1.
- B. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.
- C. Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings or standard City details. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

### **PART 2 PRODUCTS**

#### **2.1 CASTINGS**

- A. Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers if indicated on Drawings.
- B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.
- C. Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter.
- D. Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

## **2.2 BEARING SURFACES**

- A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for position in which casting may be seated in frame.

## **2.3 SPECIAL FRAMES AND COVERS**

- A. Where indicated on Drawings, provide watertight manhole frames and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.
- B. Where shown on Drawing, provide manhole frames and covers with 48 inch diameter clear opening, with inner cover for 22 inch diameter clear opening. Provide approved inner cover with pattern shown on Drawings.

## **2.4 FINISH**

- A. Unless otherwise specified, uncoated cast iron.

## **2.5 FABRICATED RING GRATE**

- A. Fabricate ring grates from reinforcing steel conforming to ASTM A 615.
- B. Conform to welds connecting bars to AWS D 12.1.

## **2.6 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS**

- A. Use castings conforming to Division 33 requirements.
- B. One piece casting with dimensions to fit frame and cover.

# **PART 3 EXECUTION**

## **3.1 INSTALLATION**

- A. Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer's printed materials.
- B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.
- C. Fabricate ring grates in accordance with City of Houston standard detail, "Ring Grate for Open End of 18 Inch to 72 Inch Stubs to Ditch". Set in mortar in mouth of pipe bell.
- D. Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

**END OF SECTION 33 49 13**