

## Request for Competitive Sealed Proposals 19CSP080 Renovations at Nelson Bus Terminal

Date	Event
December 13, 2018 December 20, 2018	Advertise/Issue Date
December 20, 2018	Pre-Proposal Conference at Nelson Bus Terminal 7105 Berkman Drive Austin, TX 78752 at 10:00 AM
January 17, 2019	Due Date for Questions by 5:00 pm
January 14, 2019	Questions and Answers posted on our website
January 17, 2019	<b>CSP opening / due date at 2:00 pm CST</b>
February 25, 2019	AISD Board Meeting for review/approval

**Deliver Sealed Proposals to:**

**Austin ISD  
Contract & Procurement Services  
1111 West 6<sup>th</sup> Street  
Building A, Suite 330  
Austin, TX 78703**

**Procurement Contact:**

**Jennifer Nix  
Construction Procurement Contract  
Coordinator  
[jennifer.nix@austinisd.org](mailto:jennifer.nix@austinisd.org)**

**HUB Coordinator Contact:**

**Gerald Green  
[gerald.green@austinisd.org](mailto:gerald.green@austinisd.org)**

- Questions must be submitted via e-mail to the contact person listed above.  
**In the e-mail subject line, type: *Questions 19CSP080 Renovations at Nelson Bus Terminal***
- Q & A and Addenda will be posted on our website: [www.austinisd.org/cp/bids](http://www.austinisd.org/cp/bids)
- Proposals are due no later than 2:00 pm on the date indicated. Your proposals must be delivered by mail or hand delivery in a sealed envelope or carton. Proposals received after the specified time shall not be considered.
- **Please submit the following:**
  - One (1) hard copy marked “original” – include signed “required” forms
  - One (1) digital copy on a flash drive – include signed “required” forms
  - One (1) hard copy marked “copy”
- FAX, e-mail or other electronic proposals **will not be accepted.**
- Proposals must be plainly marked with **name and address of the Offeror and the CSP number and Title above.**

# Project Manual

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Austin Independent School District

Nelson Bus Terminal

Austin, Texas

Austin ISD Project number: 190044-NELBT

December / 2018

PSC Project # 03768918



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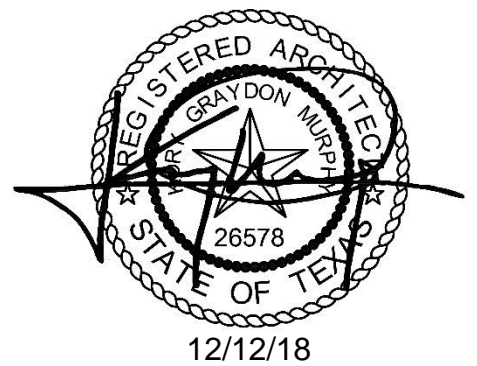


12/12/18

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**DIVISION 27 - 48**

Not Used



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The specification sections authenticated by my seal and signature are limited to the following:

**DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING**

- 23 0500 Common Work Results for HVAC
- 23 0513 Common Motor Requirements for HVAC Equipment
- 23 0529 Hangers and Supports for HVAC Piping and Equipment
- 23 0593 Testing, Adjusting, and Balancing for HVAC
- 23 0700 HVAC Insulation
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- 23 3113 Metal Ducts
- 23 5416 Gas-Fired Furnaces
- 23 8127 Split System Air Conditioners

**DIVISION 26 - ELECTRICAL**

- 26 0519 Low-Voltage Electrical Power Conductors and Cables
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## CHECKLIST AND SUBMISSION GUIDELINES

Check when Completed	Task to be Completed by Respondent
	Request For Competitive Sealed Proposal Form
	Proposal Guaranty
	Required HUB Documentation
	Review and Complete Tables from Proposal Form
	Table A – All Projects in Progress
	Table B – All School (K-12 and higher education) projects completed in the past 8 years, beginning with projects for AISD
	Table C – All Non-School projects completed in the past 8 years
	Table D – Personnel
	<b><u>Hard Copy Submission</u></b> AISD requires one (1) marked “original” and one (1) marked “copy”
	<b><u>Electronic Copy:</u></b> AISD requires submission of one (1) electronic PDF copy via USB flash drive (memory data stick)

Order for Submission	Document
1	Cover Sheet
2	Table of Contents
3	Proposal Form
4	Table A – All Projects in Progress
5	Table B – All School (K-12 and higher education) projects completed in the past 8 years, beginning with projects for AISD
6	Table C – All Non-School projects completed in the past 8 years
7	Table D – Personnel
8	Proposal Guaranty
10	Required HUB Documentation

**AISD Project No. 19CSP080 AKA 19-0044-NELBT**

**PROJECT MANUAL TABLE OF CONTENTS**

- 1. Project Title:** Austin ISD - Nelson Bus Terminal
- 2. Description of Work:** HVAC upgrades including controls. Finish upgrades including new flooring throughout as well as new ceiling tile throughout building not including shop area. New overhead door jackshaft operators and site corrections for drainage at rear of building.

**3. Architect/Engineer:** Parkhill, Smith, & Cooper, Inc.

**4. Consultants:**

Structural Engineer: N/A  
MEP Engineer(s): Jose I. Guerra, Inc.  
Electrical Engineer: Jose I. Guerra, Inc.  
Landscape Architect: Parkhill, Smith, and Cooper, Inc.

**5. Drawings:** The Drawings are as follows, and are dated \_\_\_\_\_, 20\_\_\_\_  
unless a different date is shown below.

Drawing List:

Drawing List:

G-001	Cover Sheet and Index
G-002	Accessibility Guidelines
L-101	Landscape Site Plan
L-501	Landscape Details
A-101	Floor Plan and Reflected Ceiling Plan - Demolition
A-102	Floor Plan and Reflected Ceiling Plan
A-103	Floor Plan - Shop Area
L-101	Finish Plan, Interior Material Legend, Interior Abbreviations
MD 2.1	Mechanical First Floor Demolition Plan
MD 2.2	Mechanical Mezzanine Demolition Floor Plan



M 1.0	Mechanical Legends, General Notes & Abbv
M 2.1	Mechanical First Floor Plan
M 2.2	Mechanical Mezzanine Floor Plan
M 3.0	Mechanical Schedules and Details
M 5.1	BAS Symbols & Abbreviations
M 5.2	BAS Additional Notes & Directives
M 5.3	BAS Control - MUA
M 5.4	BAS Control - RTU
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E 1.0	Electrical Legend, General Notes and Abbv
E 2.1	Electrical First Floor Plan
E 3.1	Electrical Schedules and Details

The Addenda, if any, are as follows:

<u>Number</u>	<u>Date</u>	<u>Pages</u>
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## 6. Specifications:

The Specifications are as follows:.

01 3546	Indoor Air Quality
01 7419	Construction Waste Management
01 8113	Sustainable Construction Requirements
23 0100	Commissioning of Mechanical Systems
23 0500	Common Work Results for HVAC
23 0513	Common Motor Requirements for HVAC Equipment
23 0529	Hangers and Supports for HVAC Piping and Equipment
23 0593	Testing, Adjusting, and Balancing for HVAC
23 0700	HVAC Insulation
23 0926A	Direct Digital Controls for Local Building Automation Systems Tridium-Bacnet Web-based
23 0926C	Commissioning of Building Automation System (Tridium-Bacnet)
23 2300	Refrigerant Piping
23 3113	Metal Ducts
23 5416	Gas-Fired Furnaces
23 8127	Split System Air Conditioners
26 0100	Commissioning of Electrical Systems
26 0519	Low-Voltage Electrical Power Conductors and Cables
26 0526	Grounding and Bonding for Electrical Systems
26 0529	Hangers and Supports for Electrical Systems
26 0533	Raceways and Boxes for Electrical Systems
26 0544	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
26 0553	Identification for Electrical Systems
26 0573	Overcurrent Protective Device Coordination Study
26 0575	Arc Flash Hazard Analysis Study
26 2416	Panelboards
26 2726	Wiring Devices

# REQUEST FOR COMPETITIVE SEALED PROPOSALS INSTRUCTIONS TO OFFERORS

(Chapter 2269, Subchapter D of the Texas Government Code)

Austin Independent School District ("AISD") requests proposals for a Contractor to perform the construction of the Work described below in connection with AISD's Renovations at Project (the "Project"). AISD is interested in receiving proposals from General Contractors with experience in successfully completing projects that are similar in scope, size and complexity to the Work and meeting any specialized requirements set forth below.

## 1. PROJECT

### 1.1. Scope of Work. The selected Offeror must furnish all labor, materials and equipment required for the construction of the following improvements (the "Work"):

HVAC upgrades including controls. Finish upgrades including new flooring throughout as well as new ceiling tile throughout building not including shop area. New overhead door jackshaft operators and site corrections for drainage at rear of building. Miscellaneous electrical throughout for HVAC and overhead door operators as well as panels.

### To be constructed at the following location ("Project Site"):

Nelson Bus Terminal 7105 Berkman Drive, Austin, Texas

### 1.2. Estimated Project Budget: **\$\$\$317,314.00**

### 1.3. Minimum Qualifications. Because of the nature of the Work, the selected Offeror must meet the following qualifications and/or must have any licenses or certifications specified below (collectively, the "Minimum Qualifications"):

- Section 23 0529 "Hangers and Supports for HVAC Piping:" Qualify Structural Steel Welding personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- Section 23 0593 "Testing, Adjusting, and Balancing for HVAC:" Engage a TAB firm certified by, NEBB or TABB.
- Section 23 3113 "Metal Ducts:" Qualify personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel" for hangers and supports and to AWS Dp.1M/D9.1 "Sheet Metal Welding Code" for duct joint and seam welding.
- Section 26 0519 "Low Voltage Electrical Power Conductors and Cables:" The testing agency must be an independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- Section 26 0573 "Overcurrent Protective Device Study:" A Coordination-Study Specialist shall be an entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

- 1.4. **Texas Education Code §22.0834 (Criminal History Record Information Review of Certain Contract Employees)**. For purposes of the Project, those workers who will be performing Work on the Project Site will be “covered employees” as defined in Section 3.15 of the General Conditions. Thus, Texas Education Code §22.0834 is applicable to such covered employees, and the selected Offeror must comply with the provisions of Section 3.15 of the General Conditions with regard to such covered employees.

## **2. DRAWINGS, SPECIFICATIONS, CONTRACT DOCUMENTS AND ADDENDA**

- 2.1. The “Contract Documents” for this Request For Competitive Sealed Proposals include, without limitation, AISD’s Agreement for Construction Contract (“Agreement for Construction”), AISD’s General Conditions of the Contract for Construction (“General Conditions”), and AISD’s Notice of Prevailing Wage Rates (“Notice of Prevailing Wage Rates”), collectively referred to in this Request For Competitive Sealed Proposals as the “Contract.”
- 2.2. Copies of Drawings, Specifications, Contract Documents, and Addenda (if any) and other documents related to this Request For Competitive Sealed Proposals, are available at Miller Blueprint at the location indicated in Section 3.3 below for a deposit of \$100 per set. If deposit is paid by check, check must be made payable to Austin Independent School District. The deposit will be refunded upon return of all documents in good condition to Miller Blueprint at the location indicated in Section 3.3 below within 14 calendar days after the opening of Proposals. Drawings, Specifications, Contract Documents, and Addenda (if any) can also be downloaded Miller IDS Planroom at [www.planroom.millerids.com](http://www.planroom.millerids.com). The Drawings, Specifications and Addenda (if any) are also available for viewing at various local plan rooms.
- 2.3. Printed copies of Drawings, Specifications, Contract Documents, and Addenda (if any) can be requested and picked up at the following location in accordance with Section 3.2 above:

**Miller IDS Planroom**  
**1000 East 7th Street**  
**Austin, Texas 78702**  
**Phone: (512) 381-5292**  
**Email: [planroom@millerids.com](mailto:planroom@millerids.com)**

## **3. FORMAT FOR PROPOSALS**

- 3.1. Each proposal (“Proposal”) submitted by an offeror (“Offeror”) must contain the documents listed on the submission checklist on page 2
- 3.2. Additional forms required within 24 hours of Bid Proposal Deadline to **[proconteam@austinisd.org](mailto:proconteam@austinisd.org)** :
  - The completed HUB documents pertaining to this project:
- 3.3. The Proposal information must be typed on the Proposal Form.
- 3.4. The Offeror information in Section D of the Proposal Form must be typed on Section D of the Proposal Form or on letter-size ("8½ x 11") paper if additional sheets are used. If preprinted materials, flyers or other information about the Offeror is used, it should be referenced in the submittal and included as labeled attachments.
- 3.5. The Proposal Form and other forms included in the Proposal should be stapled or bound together in a binder, so that that the pages can be easily opened and laid flat for copying.

**4. METHOD OF SELECTING CONTRACTOR**

- 4.1. The bidder/proposer MUST submit required HUB documents. If the bidder/proposer does not meet or exceed all goals, then Good Faith Effort documentation is REQUIRED. A firm MUST be compliant with Austin ISD HUB Program regulations to be considered for contract selection.
- 4.2. Not later than the 45th day after the date on which Proposals are opened, AISD will evaluate and rank each Proposal submitted in relation to the Selection Criteria set out below. AISD will select the Offeror that, in the opinion of AISD, submits the Proposal that offers the best value for AISD based on the Selection Criteria and the weighted value for each Selection Criteria and on AISD's ranking evaluation. The Offeror that offers the best value may or may not be the Offeror that submits the lowest proposal for the cost of construction.
- 4.3. The AISD Construction Management Department will make a recommendation to the Board of Trustees as to the selection ranking of the Offerors. The Board of Trustees will select the Offeror that submits the Proposal that offers the best value for AISD and will authorize the negotiation and execution of the contract. If AISD is unable to negotiate a satisfactory contract with the selected Offeror, AISD shall, formally and in writing, end negotiations with that Offeror and proceed to the next Offeror in the order of the selection ranking until a contract is reached or all proposals are rejected. AISD reserves the right to reject any and all proposals.

**5. SELECTION CRITERIA**

- 5.1. Offerors will be evaluated based on the following selection criteria and weighted value for each criterion (collectively, "Selection Criteria"):

<u>Selection Criteria</u>	<u>Weighted Value</u>
<b>Construction Cost as Proposed</b>	<b>45%</b>
<b>Relevant Experience and Past Performance</b>	<b>30%</b>
<b>Proposed Personnel/Resources</b>	<b>10%</b>
<b>Financial Condition</b>	<b>8%</b>
<b>Safety Record</b>	<b>7%</b>

**6. QUESTIONS REGARDING THIS REQUEST FOR COMPETITIVE SEALED PROPOSALS**

- 6.1. Only those responses to inquiries which are made by formal written Addenda shall be binding. Oral and other interpretations or clarifications will be without legal effect, and shall not be binding on AISD. The Offeror must acknowledge receipt of all Addenda in its Proposal. However, each Offeror will be bound by the terms of all Addenda, and its Proposal will be construed to include the information contained in the Addenda, whether or not Offeror has received them or acknowledged receipt.

**7. PROPOSAL GUARANTY**

- 7.1. Each Proposal must be accompanied by a Proposal Guaranty in the amount of five percent (5%) of the largest possible total Proposal (i.e. the sum of the Base Proposal and all additive Alternates).
- 7.2. The Proposal Guaranty shall be in the form of a Proposal Bond in the form included with this Request For Competitive Sealed Proposals issued by a corporate surety authorized to do business in the State of Texas that is listed on the U.S. Treasury list of approved sureties.

- 7.3. The Proposal Guaranty will be held until the selected Offeror has signed the Contract and provided the required insurance and payment and performance bonds and Safety Program Manual and Safety Plan as provided in these instructions.
- 7.4. Should the selected Offeror fail or refuse to sign the Contract and/or provide the required insurance and payment and performance bonds and Safety Program Manual and Safety Plan as provided in these instructions, then the Offeror's Proposal Guaranty will be forfeited to AISD as liquidated damages and not as a penalty.

## **8. SUBSTITUTION OF MATERIALS**

- 8.1. Offerors may request a substitution of materials or equipment specified in the Contract Documents. However, any such request must be submitted in writing to the Contact Person five days before the Proposal Deadline. If AISD approves the substitution, it will respond by Addendum as described in Section 11. A failure to respond will constitute a denial of the request. Sufficient information should accompany the request to enable AISD to promptly render a decision on a proposed substitution of materials or equipment.

## **9. BOND AND INSURANCE REQUIREMENTS**

- 9.1. Insurance meeting the requirements set out in the General Conditions must be furnished by the selected Offeror within 5 days after the Contract is signed by the Offeror.
- 9.2. If the Contract amount is over \$25,000, the selected Offeror must provide payment and performance bonds each in the amount of 100% of the Contract Price within 5 days after the Contract is signed by the Offeror. Bonds must be provided by a Treasury-listed corporate Surety authorized to do business in the State of Texas.
- 9.3. The Offeror's attention is directed to Subsection 10.4 of the General Conditions which expressly sets out the Worker's Compensation Insurance requirements for the Project. The Contractor and each subcontractor must maintain Worker's Compensation Insurance coverage as required in Subsection 10.4 and the Contractor is required to provide a certificate of coverage for each subcontractor prior to that subcontractor beginning Work on the Project Site, showing that coverage is being provided for all of its employees for the duration of the Work. Subsection 10.4 is incorporated herein for all purposes.

## **10. SAFETY PROGRAM MANUAL AND PROJECT SAFETY PLAN REQUIREMENTS**

- 10.1. The selected Offeror must submit its Safety Program Manual in accordance with the requirements set out in the General Conditions not later than 5 days after the Offeror signs the Contract.
- 10.2. The selected Offeror must submit a Safety Plan for the Project meeting the requirements set out in the General Conditions not later than 5 days after the Offeror signs the Contract.

## **11. PREVAILING WAGE RATES**

- 11.1. The Contractor and each Subcontractor who performs work under the Contract must pay, at a minimum, the applicable prevailing wage rates to a worker employed by it in the performance of the Work. The prevailing wage rates applicable to the Project, which shall be in effect for the duration of the Contract, are set forth in the Notice of Prevailing Wage Rates.

## **12. EXAMINATION OF SITE AND CONTRACT DOCUMENTS**

- 12.1. Each Offeror is required to visit the Project Site and to fully acquaint itself with the conditions and limitations as they exist at the Project Site, including the effect that weather conditions may have on the Project Site. Each Offeror shall also fully acquaint itself with the existing and anticipated sources and supplies of labor and materials, and shall also thoroughly examine the

Contract Documents. Failure of the Offeror to visit the Project Site and acquaint itself with the conditions of the Work and the Contract Documents shall in no way relieve the Offeror from any obligations with respect to its Proposal.

**13. PUBLIC INFORMATION**

- 13.1. AISD considers all information, documentation and other materials requested to be submitted in response to this solicitation to be of a non-confidential and/or non-proprietary nature and therefore shall be subject to public disclosure under the Texas Public Information Act (Tex. Gov't Code, Chapter 552.001, *et seq.*) after a contract is awarded.
- 13.2. Offerors are hereby notified that AISD strictly adheres to all statutes, court decisions, and opinions of the Texas Attorney General with respect to disclosure of public information.

**14. DEADLINE FOR SIGNING CONTRACT AND AISD'S RIGHTS IF DELAY**

- 14.1. The timely completion of this Project is essential. AISD has the right to consider negotiations with the selected Offeror for the Contract incomplete until and unless the Contract is signed and the bonds, insurance, Safety Program Manual and Safety Plan are submitted in accordance with the following deadlines. In order to avoid unnecessary delays in the Project, **the selected Offeror must:**

1. Sign the Contract no later than 10 days after the selected Offeror has been notified that it is the successful Offeror, and
2. Provide its Safety Program Manual and the Safety Plan for the Project and provide all required bonds within 5 days after the selected Offeror signs the Contract.
3. Provide Certificate of Insurance before Work commences on the Project.

- 14.2. If the selected Offeror fails to meet one or more of these deadlines, then in addition to any and all other rights and remedies to which AISD is entitled, AISD shall have the right to:

1. Terminate its negotiations with the selected Offeror and begin negotiations with the next ranked Offeror; or
2. Proceed with the Contract with selected Offeror, but treat each day beyond the 10-day deadline in which the Contract is unsigned by the Offeror, and/or each day beyond the 5 day deadline in which one or more of the required documents has not been submitted, as a day of unexcused delay under the Contract.

**15. WAIVER OF CLAIMS**

- 15.1. **EACH OFFEROR BY SUBMISSION OF A PROPOSAL TO THIS REQUEST FOR COMPETITIVE SEALED PROPOSALS WAIVES ANY CLAIMS IT HAS OR MAY HAVE AGAINST THE ARCHITECT, ITS CONSULTING ENGINEERS, OR ANY OTHER CONSULTANTS, AND THEIR RESPECTIVE EMPLOYEES, OFFICERS, MEMBERS, DIRECTORS AND PARTNERS, AND AISD, ITS EMPLOYEES, OFFICERS, AGENTS, REPRESENTATIVES, AND THE MEMBERS OF AUSTIN INDEPENDENT SCHOOL DISTRICT'S GOVERNING BODY, CONNECTED WITH OR ARISING OUT OF THIS REQUEST FOR COMPETITIVE SEALED PROPOSALS, INCLUDING, THE ADMINISTRATION OF THE REQUEST FOR COMPETITIVE SEALED PROPOSALS, THE PROPOSAL EVALUATIONS, AND THE SELECTION OF THE OFFEROR. SUBMISSION OF A PROPOSAL INDICATES OFFEROR'S ACCEPTANCE OF THE EVALUATION TECHNIQUE AND OFFEROR'S RECOGNITION THAT SOME SUBJECTIVE JUDGMENTS**

**MUST BE MADE BY AISD DURING THE SELECTION PROCESS. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, EACH OFFEROR ACKNOWLEDGES THAT AISD SHALL DOCUMENT THE BASIS OF ITS SELECTION AND SHALL MAKE THE EVALUATIONS PUBLIC NOT LATER THAN THE 7TH DAY AFTER THE DATE THE CONTRACT IS AWARDED, AND EACH OFFEROR WAIVES ANY CLAIM IT HAS OR MAY HAVE AGAINST THE ABOVE-NAMED PERSONS, DUE TO INFORMATION CONTAINED IN SUCH EVALUATIONS.**

**16. CONFLICT OF INTEREST QUESTIONNAIRE**

- 16.1. Offeror is advised to determine if it is required under Chapter 176 of the Texas Local Government Code to file a completed conflict of interest questionnaire with AISD. If Offeror is required by law to complete the questionnaire, the Conflict of Interest Questionnaire (Form CIQ) should be completed and submitted online at:

<http://www.austinisd.org/inside/hb914/ciqform.phtml>.

**17. DISCLOSURE OF INTERESTED PARTIES**

- 17.1. In 2015, the Texas Legislature adopted House Bill 1295, which added section 2252.908 of the Texas Government Code. The law states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The disclosure requirement applies to a contract entered into on or after January 1, 2016.
- 17.2. After the AISD Board of Trustees selects the Offeror, the successful Offeror will be required to complete an electronic Form 1295 ("Form 1295") on the Texas Ethics Commission website ([https://www.ethics.state.tx.us/whatsnew/elf\\_info\\_form1295.htm](https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm)) and submit the completed and executed Form 1295, including the certification of filing, to AISD prior to entering into a contract with AISD in accordance with this statute. Additional information is available on the Texas Ethics Commission website at [www.ethics.state.tx.us](http://www.ethics.state.tx.us). Submission of a response to this Request For Competitive Sealed Proposals indicates Offeror's acceptance and intended compliance with these requirements.

**18. FEEDBACK TO SUBCONTRACTORS/SUPPLIERS**

- 18.1. If requested by a subcontractor or material supplier who submitted a bid or proposal to Offeror in connection with this procurement but who is not listed as a proposed subcontractor or supplier on Offeror's completed Disclosure Statement, Offeror shall provide feedback to such subcontractor or supplier as to how its bid/proposal compared with the other bids/proposals received by Offeror for the same services or materials (e.g., bid was highest bid received, bid fell in the middle of bids received, etc.).

**19. SOLICITATION OF "COMPONENT" BIDS AND PROPOSALS FROM SUBCONTRACTORS**

- 19.1. In order to promote and encourage the involvement of small, local firms and firms owned or operated by minorities or women, Offeror must solicit and consider bids/proposals from subcontractors covering only certain components of the scope of the Work for which particular bids/proposals are solicited, in addition to soliciting and considering bids/proposals from subcontractors for complete scopes of the Work.

# PROPOSAL FORM

To: The Board of Trustees  
Austin Independent School District  
Austin, Texas

Re: AISD CSP No. **19CSP080**

From: \_\_\_\_\_  
(Full legal name of firm, including DBA, if applicable)

Project Number: **19-0044-NELBT**

Project Title: **Nelson Bus Terminal**

The undersigned offeror ("Offeror") submits this Proposal for the performance of the Work of construction, alteration or repair (the "Work") described as follows:

**HVAC upgrades including controls. Finish upgrades including new flooring throughout as well as new ceiling tile throughout building not including shop area. New overhead door jackshaft operators and site corrections for drainage at rear of building. Miscellaneous electrical throughout for HVAC and overhead door operators as well as panels.**

The undersigned Offeror has carefully examined and considered the Project Site and relevant conditions and circumstances for the Work, information and requirements set out in the Request For Competitive Sealed Proposals, the Drawings and Specifications, and the requirements of the proposed Contract Documents, including the Agreement for Construction, the General Conditions and the Notice of Prevailing Wage Rates, in making this Proposal. Capitalized terms used but not otherwise defined in this Proposal Form shall have the same meanings as designated in the Request For Competitive Sealed Proposals.

**A.1 Pricing Schedule** (Express in words and numbers.)

Base Proposal \_\_\_\_\_  
\_\_\_\_\_  
(\$ \_\_\_\_\_ )

\*If applicable, indicate the amount of HAZMAT Abatement included in the Base Proposal.  
\_\_\_\_\_  
\_\_\_\_\_  
(\$ \_\_\_\_\_ )

**A.2 Substantial Completion Date**

All of the Work must be substantially completed no later than **August 15, 2019**

**A.3 Liquidated Damages**

AISD shall have the right under the Contract to assess liquidated damages for each and every calendar day beyond the Substantial Completion Date set out in the Contract that the Work fails to be substantially complete in the following amount per day: **\$100**



**B. Enclosed Documents**

The following are enclosed with this completed Proposal:

**B.1 Proposal Guaranty**

A Proposal Guaranty in the amount of 5% of the maximum total proposed Contract Amount (i.e. the sum of the Base Proposal and all additive Alternates) in the form of either a cashier's check payable to Austin Independent School District or a Proposal Bond on the required Proposal/Bid Bond Form.

**B.2 Other Documents Due**

The following are enclosed with this Proposal and **due NO MORE than 24 hours after** the Proposal regarding the Work:

**The required HUB documents requested for the project**

**C. Offeror Representations and Certifications**

**C.1 By signing and submitting this Proposal, the undersigned Offeror and person signing on its behalf certifies and represents to the Austin Independent School District as follows:**

- C.1.1 Offeror has not offered, conferred or agreed to confer any pecuniary benefit, as defined by Tex. Penal Code, Chapter 36, or any other thing of value, as consideration for the receipt of information or any special treatment or advantage relating to this Proposal;
- C.1.2 Offeror has not offered, conferred or agreed to confer any pecuniary benefit or other thing of value as consideration for the recipient's decision, opinion, recommendation, vote or other exercise of discretion concerning this Proposal;
- C.1.3 Offeror has not violated any state, federal or local law, regulation or ordinance relating to bribery, improper influence, collusion or the like, and Offeror will not in the future offer, confer, or agree to confer any pecuniary benefit or other thing of value to any officer, Trustee, agent or employee of the Austin Independent School District in return for the person's having exercised official discretion, power or duty with respect to this Proposal;
- C.1.4 Offeror has not now and will not in the future offer, confer or agree to confer a pecuniary benefit or other thing of value to any officer, Trustee, agent or employee of the Austin Independent School District in connection with information regarding this Proposal, the submission of this Proposal, the award of this Proposal, or the performance, delivery or sale pursuant to this Proposal;
- C.1.5 Offeror has neither coerced nor attempted to influence the exercise of discretion by any officer, Trustee, agent or employee of the Austin Independent School District concerning this Proposal on the basis of any consideration not authorized by law; and

- C.1.6 Offeror has not received any information not available to other offerors so as to give the undersigned a preferential advantage with respect to this Proposal.
- C.2 All information contained in this Proposal, including the information provided in Section D below is, to the best of the undersigned's knowledge and belief, true, complete and accurate.
- C.3 **OFFEROR WAIVES ANY CLAIM IT HAS OR MAY HAVE AGAINST THE ARCHITECT, ITS CONSULTING ENGINEERS, OR ANY OTHER CONSULTANTS, AND THEIR RESPECTIVE EMPLOYEES, OFFICERS, MEMBERS, DIRECTORS AND PARTNERS, AND AISD, ITS EMPLOYEES, OFFICERS, AGENTS, REPRESENTATIVES, AND THE MEMBERS OF AISD'S GOVERNING BODY, CONNECTED WITH OR ARISING OUT OF THIS REQUEST FOR COMPETITIVE SEALED PROPOSALS, INCLUDING, THE ADMINISTRATION OF THE REQUEST FOR COMPETITIVE SEALED PROPOSALS, THE PROPOSAL EVALUATIONS, AND THE SELECTION OF THE OFFEROR. SUBMISSION OF A PROPOSAL INDICATES OFFEROR'S ACCEPTANCE OF THE EVALUATION TECHNIQUE AND OFFEROR'S RECOGNITION THAT SOME SUBJECTIVE JUDGMENTS MUST BE MADE BY AISD DURING THE SELECTION PROCESS. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, OFFEROR ACKNOWLEDGES THAT AISD SHALL DOCUMENT THE BASIS OF ITS SELECTION AND SHALL MAKE THE EVALUATIONS PUBLIC NOT LATER THAN THE 7TH DAY AFTER THE DATE THE CONTRACT IS AWARDED, AND OFFEROR WAIVES ANY CLAIM IT HAS OR MAY HAVE AGAINST THE ABOVE-NAMED PERSONS, DUE TO INFORMATION CONTAINED IN SUCH EVALUATIONS.**
- C.4 Offeror has received the following Addenda to the Request For Competitive Sealed Proposals, but agrees and understands that it will be responsible for performing the Work in accordance with all terms and conditions in all Addenda issued in connection with the Request For Competitive Sealed Proposals, and that its Proposal will be construed to include all requirements of all such Addenda, whether or not identified here:  
Addenda No.(s) \_\_\_\_\_
- C.5 Offeror (or its subcontractors/suppliers, as applicable) meets all of the Minimum Qualifications specified in Section 1.3 of the Request For Competitive Sealed Proposals.
- C.6 The subcontractors/suppliers listed on the completed Disclosure Statement meet all of the qualifications for the Project set forth in AISD's Project Manual/Specifications.
- C.7 If requested by a subcontractor or material supplier who submitted a bid/proposal to Offeror in connection with the Work but who is not listed as a proposed subcontractor or supplier on Offeror's completed Disclosure Statement, Offeror will provide feedback to such subcontractor or supplier as to how its bid/proposal compared with the other bids/proposals received by Offeror for the same services or materials in connection with the Work (e.g., bid was highest bid received, bid fell in the middle of bids received, etc.).
- C.8 To promote and encourage the involvement of small, local firms and firms owned or operated by minorities or women, Offeror will solicit and consider bids/proposals from subcontractors covering only certain components of the scope of the Work for which particular bids/proposals are solicited, in addition to soliciting and considering bids/proposals from subcontractors for complete scopes of the Work.

**D. Offeror Information**

All of the following information must be provided by Offeror. Use additional sheets if necessary. If additional sheets are used, clearly indicate the question number to which you are responding. Responses must be typed or printed neatly. Illegible responses will not be considered. The Offeror is also sometimes hereinafter referred to below as the "organization" or the "company."

**D.1 General Information**

D.1.1 Name of Offeror: \_\_\_\_\_

D.1.2 Name of Project: \_\_\_\_\_  
\_\_\_\_\_

D.1.3 Address of office from which Offeror will conduct the Work:  
\_\_\_\_\_

D.1.4 Offeror's Contact Person for this Work:  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_ Phone: \_\_\_\_\_

D.1.5 Offeror's Home Office Address:  
\_\_\_\_\_

D.1.6 Does any relationship exist between the Offeror, its officers, principals, or employees and any of AISD's officers, or Trustees?  YES  NO  
If yes, please explain. \_\_\_\_\_

D.1.7 Principal Business:  
 General Construction  Mechanical/Electrical/Plumbing  
 Roofing  Interior Finish-out  
 Other (Please specify) \_\_\_\_\_

D.1.8 Licensing/Certifications for Prime Contractors:  
List trade categories in which your organization is legally qualified to do business in Austin, Texas, and indicate registration or license numbers, as applicable.

If a Technology, Fire Alarm, Security or Roofing specialty contractor, please provide a list of each manufacturer with which your organization is authorized/certified to supply, service and install their products. Submit letters and certificates from the manufacturers, on manufacturers' letterheads, regarding the authorization to supply, service and install their products and, in addition, provide copies of certifications for the various personnel involved in the Project.

D.1.9 Minimum Qualifications:  
To the extent not otherwise described in Section 1.8 above, describe your organization's compliance with all Minimum Qualifications set forth in Section 1.3 of the Request For Competitive Sealed Proposals and include all necessary attachments evidencing same.

D.1.10 Work to be Performed on this Project by Offeror's Own Forces:  
List the general categories of work that your organization intends to perform on this Project using its own forces.  
\_\_\_\_\_

**D.2 Organization**

D.2.1 How many years has your organization been in business as a contractor? \_\_\_\_\_

D.2.2 How many years has your organization been in business under its present business name? \_\_\_\_\_

D.2.3 Under what other or former names has your organization operated?

Name: \_\_\_\_\_ Years: \_\_\_\_\_

Name: \_\_\_\_\_ Years: \_\_\_\_\_

D.2.4 If your organization is a corporation, answer the following:

Date of incorporation: \_\_\_\_\_ State of incorporation: \_\_\_\_\_

President's name: \_\_\_\_\_

D.2.5 If your organization is a limited liability company, answer the following:

Date of organization: \_\_\_\_\_ State of organization: \_\_\_\_\_

President's, Manager's or Managing Member's name: \_\_\_\_\_

D.2.6 If your organization is a partnership, answer the following:

Date of organization: \_\_\_\_\_ Type of Partnership: \_\_\_\_\_

Name(s) of general partner(s): \_\_\_\_\_

D.2.7 If your organization is individually owned, answer the following:

Date of organization: \_\_\_\_\_ Name of owner: \_\_\_\_\_

D.2.8 For all business entities other than publicly held corporations, provide the following:

Award to Nonresident Bidders

Is your business organized under the laws of the State of Texas?  YES  NO

What is the location of your principal place of business?

\_\_\_\_\_  
Proposals from nonresident contractors shall be evaluated according to Tex. Gov. Code § 2252.002.

D.2.9 Is your company currently for sale or involved in any transaction to expand or to become acquired by another business entity? If yes, please explain the impact both in organizational and directional terms. \_\_\_\_\_

**D.3 Relevant Experience**

D.3.1 **On the attached Table A**, list all projects your company has in progress and provide all additional information requested.

D.3.2 **On the attached Table B**, list all school projects that your company has completed in the past eight (8) years, beginning with AISD schools, and provide all additional information requested. As used herein, "school" means K-12 and higher education.

D.3.3 **On the attached Table C**, list all non-school projects your company has completed in the past eight (8) years and provide all additional information requested.

D.3.4 Describe the way in which your company develops and maintains project schedules. How often do you update schedules? **Limit your response to one page.**

**D.4 Past Performance**

D.4.1 Claims and Suits. (If the answer to any of the questions below is yes, please attach details not to exceed one page for each of the following questions.)

Has your organization ever failed to complete any work awarded to it? (If yes, attach details.)

YES  NO

D.4.2 Are there any judgments, claims, arbitration proceedings or suits (past, pending or outstanding) against your organization or its officers arising out of or in connection with your company's performance under a contract for construction management and/or construction services? (If yes, attach details, including a description of how such suits or claims were resolved, if applicable.)

YES  NO

D.4.3 Has your organization filed any law suits or requested arbitration with regard to construction contracts within the last five years? (If yes, attach details.)

YES  NO

D.4.4 Has your organization been assessed liquidated damages on a project in the last eight (8) years? (If yes, attach details.)

YES  NO

D.4.5 Within the last five years, has any officer or principal of your organization ever been an officer or principal of **another** organization when it failed to complete a construction contract? (If yes, attach details.)

YES  NO

D.4.6 Trade References. Provide the following information for three trade references:

Company name: \_\_\_\_\_

Contact person: \_\_\_\_\_

Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

Company name: \_\_\_\_\_

Contact person: \_\_\_\_\_

Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

Company name: \_\_\_\_\_

Contact person: \_\_\_\_\_

Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

**D.5 Personnel**

D.5.1 **On the attached Table D**, list the names of the key individuals [Project Manager, Construction Superintendent, Assistant Superintendent (if applicable), and Field Engineer(s)] of your organization which are proposed to be assigned to this Project and provide the additional information requested on Table D. For each key individual listed on Table D, provide a resume (not to exceed 2 pages) which includes the key individual's construction experience and a description of his/her qualifications and experience relative to the Project.

**D.6 Financial**

Bank References - Provide the following information for three Bank references:

Company name: \_\_\_\_\_  
Contact person: \_\_\_\_\_  
Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

Company name: \_\_\_\_\_  
Contact person: \_\_\_\_\_  
Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

Company name: \_\_\_\_\_  
Contact person: \_\_\_\_\_  
Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

**D.6.1**

Surety:

D.6.1.1 Name of your organization's bonding company:

\_\_\_\_\_

D.6.1.2 Name, address and phone number of agent:

Company name: \_\_\_\_\_  
Contact person: \_\_\_\_\_  
Address : \_\_\_\_\_ Telephone: \_\_\_\_\_  
\_\_\_\_\_

**D.6.2**

Financial Statement. All statements submitted will be used exclusively by AISD in the evaluation of the award of the contract on the underlying project. Statements will be kept confidential to the extent permitted by law.

**D.6.2.1 Attach an audited or reviewed financial statement, including an independent auditor's report, balance sheet, income statement, and the related notes to the financial statement. Financial statements that are more than one-year old are not acceptable.**

D.6.2.2 Name and address of firm preparing attached financial statement, and date thereof:

Company name: \_\_\_\_\_  
Contact person: \_\_\_\_\_  
Address : \_\_\_\_\_ Telephone: \_\_\_\_\_

**D.6.3**

If financial statements for an affiliate of the organization are also attached, will such organization act as guarantor of the contract for construction?

YES  NO

State whether your company is currently in default on any loan agreement or financing agreement with any bank, financial institution, or other entity? (If yes, specify date(s), details, circumstances, and prospects for resolution.)

**D.6.4**

State whether your company is currently contemplating or has pending a petition in bankruptcy for debt relief, or whether a creditor has threatened to file an involuntary petition against Offeror.

## D.7 Safety Record

D.7.1 Please provide the following information in connection with your organization's safety record:

7.1.1 Your organization's OSHA (Occupational Safety and Health Administration) 300 Logs for the last three completed Calendar (3) years.

- OSHA log must be completed signed and dated. If no accidents, record "0" in appropriate column totals.

7.1.2 Loss run from your organization's insurance carrier or insurance agent covering your organization's workers' compensation insurance coverage. (Loss run is also referred to as "statement of claims" or SOC.) A loss analysis/loss summary may be submitted as long as it contains individual claims descriptions.

- Loss run must be provided by your organization's insurance carrier or insurance agent. Insurance carrier's company name or insurance agent (agency) must be clearly legible on documents provided.
- Names of claimants on loss run may be redacted/blackout.
- If there have been no losses, provide copy from your firm's insurance carrier stating no losses.
- Loss run/Loss Analysis/Loss Summary must be from the most recently completed policy year.

7.1.3 Loss ratio from your organization's insurance carrier or insurance agent covering your organization's workers' compensation insurance coverage.

- Loss ratio must be provided by your organization's insurance carrier or insurance agent. Insurance carrier's company name or insurance agent (agency) must be clearly legible on documents provided.
- Time period corresponding to loss ratio must be provided for the most recent completed policy year.
- Typed or handwritten information concerning loss ratio prepared by your firm WILL NOT be accepted.
- Experience rating documents WILL NOT be accepted for this Paragraph 7.1.3.11
- If your Loss Run/Loss Analysis/Loss Summary for the most completed policy period indicates no losses, then a separate document showing 0 % loss ratio will not be required.

7.1.4 Your organization's current experience modifier from your organization's workers' compensation insurance premiums provided by your organization's insurance carrier, insurance agent or rating agency.

- Experience modifier must be provided by your organization's insurance carrier, insurance agent or rating agency. Insurance

carrier's company name or insurance agent (agency) must be clearly legible on documents provided.

- Experience modifier must clearly indicate time period/year covered.
- Hand-written experience modifiers WILL NOT be accepted.
- Experience rating documents indicating a calculated experience modifier will be accepted provided there is a final calculated experience modifier with applicable year indicated

Executed as of this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

Offeror: \_\_\_\_\_  
(Full legal name of firm, including DBA, if applicable)

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

City, State, Zip Code: \_\_\_\_\_

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

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

Title: \_\_\_\_\_

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

Telephone: \_\_\_\_\_

Email: \_\_\_\_\_  
\_\_\_\_\_



**Table A - All Projects in Progress**

Project Name	Owner	Owner's Contact Person and Phone Number	Architect	Architect's Contact Person and Phone Number	Contract Amount	Percent Complete	Scheduled Completion Date
1							
2							
3							
4							
5							
6							
Total Value of All Projects in Progress:      \$ _____							

**Table B - All School (K-12 and higher education) projects completed in the past 8 years, beginning with projects for AISD**

	Project Name	Owner	Owner's Contact Person and Phone Number	Architect	Architect's Contact Person and Phone Number	Original Contract Amount	Total Change Order Amount	Final Contract Amount	Date of Completion	% of work completed with Own Forces	Liquidated Damages (Yes or No)
1											
2											
3											
4											
5											
6											
Total Value of All School Projects Completed in the Past 8 Years: \$ _____											

**Table C - All Non-School projects completed in the past 8 years**

Project Name	Owner	Owner's Contact Person and Phone Number	Architect	Architect's Contact Person and Phone Number	Original Contract Amount	Total Change Order Amount	Final Contract Amount	Date of Completion	% of work completed with Own Forces	Liquidated Damages (Yes or No)
1										
2										
3										
4										
5										
6										
Total Value of All Non-School Projects Completed in the Past 8 Years:    \$ _____										

**Table D – Personnel**

Key Individuals	Number of years with this Company	Commitment for duration of the Project (Yes or No)	Number of school projects this team of key individuals has completed together: _____  Number of non-school projects this team of key individuals has completed together: _____
Project Manager (Name):			
Construction Superintendent (Name):			
Assistant Superintendent (Name):			
Field Engineer (Name):			
List below the names of all school and non-school projects that at least two of the key individuals listed above have worked on together:			
1.	2.		
3.	4.		
5.	6.		
7.	8.		
9.	10.		
11.	12.		
13.	14.		
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**AISD PROJECT NO. \_\_\_\_\_**

**AGREEMENT FOR CONSTRUCTION CONTRACT**

This Agreement for Construction Contract (“Agreement”) is

between the Owner:

Austin Independent School District  
1111 West 6<sup>th</sup> Street, Suite A-330  
Austin, Texas 78703  
Attn: Executive Director, Contract and Procurement Services  
Phone: 512-414-2161

and the Contractor:

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

for the following Project:

**WITNESSETH:**

Article 1. Statement of Work. Contractor shall furnish all materials, supplies, labor, services and equipment required for the following-described Work of construction, alteration or repair for the Project:

Such Work is more particularly described in the other Contract Documents incorporated in this Agreement.

Article 2. Contract Documents. This Agreement includes Owner's General Conditions of the Contract for Construction dated \_\_\_\_\_ ("General Conditions"), which is incorporated herein for all purposes, and the Contract Documents as defined therein. Capitalized terms used but not otherwise defined in this Agreement shall have the same meanings as designated in the General Conditions.

### Article 3. Contract Time.

3.1 Contractor will commence the Work within 10 days after the date specified in the Notice to Proceed issued by Owner (such date specified in the Notice to Proceed called the "Commencement Date") and will substantially complete the Work by \_\_\_\_\_ ("Substantial Completion Date"). Contractor will finally complete the Work no later than 30 days thereafter, unless a different time for Final Completion is specified by Architect/Engineer in the Certificate of Substantial Completion.

3.2 Contractor shall not commence the Work until Contractor has provided Owner with (i) a Certificate of Insurance showing that the required insurance coverage is in place, (ii) the required Payment and Performance Bonds, (iii) Contractor's Safety Program Manual, and (iv) Contractor's Safety Plan, and Owner has approved the insurance and bonds and has reviewed the Safety Program Manual and Safety Plan. Any review or approval process is for the benefit of Owner only, and does not relieve the Contractor from its obligation to comply with the requirements of the Contract Documents.

3.3 As provided in the Solicitation Documents, Contractor had a period of 10 days from the date Contractor was notified of the award of Contract to execute this Agreement, and 5 days after the date the Agreement was signed by Contractor in which to provide the insurance, bonds, Safety Program Manual and Safety Plan required by the Contract Documents. If Contractor failed to sign this Agreement within the 10 day time period, and/or to submit any of the required documentation within the 5 day time period, then Owner shall not be required to extend the Substantial Completion Date and Owner has the right to treat each day beyond the 10 day deadline in which this Agreement was unsigned, and/or each day beyond the 5 day deadline in which one or more of the required documents had not been submitted, as a day of unexcused delay under the Agreement, which in some circumstances will have the effect of reducing the number of calendar days in the Contract Time in Section 3.1 hereof to complete the Work.

Article 4. Contract Amount. For performance of the Work, Owner will pay to Contractor a Contract Amount of \$\_\_\_\_\_ computed as shown in the following Pricing Schedule, but subject to adjustment as provided in the Contract Documents:

**Pricing Schedule**

Base Bid: \$ \_\_\_\_\_

Alternates: \_\_\_\_\_

The Contract Amount includes the following Addenda:

No \_\_\_\_\_ Date Issued: \_\_\_\_\_ Pages: \_\_\_\_\_

Unit Prices for this Agreement are:

\_\_\_\_\_

Total: \$ \_\_\_\_\_

Article 5. Payments. Owner will make payments to the Contractor in accordance with the provisions set out in the General Conditions. Retainage shall be withheld by Owner as provided in the General Conditions.

Article 6. Bonds and Insurance. Contractor is required to provide Payment and Performance Bonds and Insurance prior to commencing Work, in accordance with the requirements set out in the General Conditions.

Article 7. Other Obligations. Contractor will comply with all requirements set forth in the other Contract Documents.

Article 8. Liquidated Damages. Owner shall have the right to assess liquidated damages in the amount of \$ \_\_\_\_\_ per day for each and every calendar day beyond the Substantial



Completion Date that Contractor fails to achieve Substantial Completion of the Work. Any sums due and payable hereunder by the Contractor shall be payable, not as a penalty, but as liquidated damages representing an estimate of delay damages likely to be sustained by Owner, estimated at or before the time of executing this Agreement. Any amounts due hereunder shall be paid by Contractor within ten (10) days following notice from Owner of the amount due. When the Owner reasonably believes that Substantial Completion will be inexcusably delayed, the Owner shall be entitled, but not required to, withhold from any amounts otherwise due the Contractor an amount then believed by the Owner to be adequate to recover liquidated damages applicable to such delays. If and when the Contractor overcomes the delay in achieving Substantial Completion, or any part thereof, for which the Owner has withheld payment, the Owner shall promptly release to the Contractor those funds withheld, but no longer applicable, as liquidated damages.

Article 9. Notice. All notices required to be given under this Agreement must be in writing. Any notice required or permitted to be given under this Agreement shall be deemed delivered upon deposit in the U. S. Mail, when sent by certified mail, return receipt requested, postage prepaid, correctly addressed to the party as set forth below with a copy sent to such party by e-mail on the date of deposit into the mail:

If to Owner:                    Austin Independent School District  
   1111 West 6<sup>th</sup> Street, Suite A-330  
   Austin, Texas 78703  
   Attn: Executive Director, Contract and Procurement Services  
   Phone: 512-414-2161

With copy to Architect/Engineer:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Telephone: \_\_\_\_\_  
Email: \_\_\_\_\_

If to Contractor:

\_\_\_\_\_  
\_\_\_\_\_  
Attn: \_\_\_\_\_  
Telephone: \_\_\_\_\_  
Email: \_\_\_\_\_

Notice given in any other manner will be deemed delivered if and when actually received. Either party may change its address for notice by providing notice to the other party as provided herein. Such change of address will be effective 14 days after it is delivered.

Article 10. Prevailing Wage Rates. Contractor shall comply with the prevailing wage rate requirements set forth in Chapter 2258 of the Texas Government Code, and shall require subcontractors to comply with the applicable provisions of said law. For the duration of this Agreement, Contractor and each subcontractor shall pay not less than the prevailing wage rates, including fringe benefits, set forth in the Notice of Prevailing Wage Rates.

Article 11. Worker's Compensation Insurance. Pursuant to Section 406.096 of the Texas Labor Code, by execution of the Agreement, Contractor certifies to Owner that it has Worker's Compensation Insurance coverage for each employee of the Contractor employed on this Project. Contractor shall obtain from each subcontractor a certificate which certifies that the subcontractor has Worker's Compensation insurance coverage for each employee of the subcontractor employed on this Project and shall promptly provide Owner with all such certificates.

Article 12. Miscellaneous. Contractor certifies that it is not a company identified on the Texas Comptroller's list of companies known to have contracts with, or provide services to, a foreign organization designated as a Foreign Terrorist Organization by the U.S. Secretary of State under federal law.

Article 13. Miscellaneous. Contractor certifies and verifies that neither Contractor and Contractor Companies will not boycott Israel during the term of this Agreement. For purposes of this Agreement, the term "boycott" shall mean and include terminating business activities or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory.

Executed by Contractor on the date set forth below, but to be effective as of the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, which date shall be filled in by Owner at the time it executes this Agreement.

OWNER:

AUSTIN INDEPENDENT SCHOOL DISTRICT

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

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

Title: \_\_\_\_\_

CONTRACTOR:

\_\_\_\_\_

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

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

Title: \_\_\_\_\_

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

# **GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION**

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**GENERAL CONDITIONS OF THE CONTRACT**  
**FOR CONSTRUCTION**

**1. Article 1. GENERAL PROVISIONS**

1.1 DEFINITIONS

- A. “Agreement” means, as applicable, AISD’s Agreement for Construction Contract between Owner and Contractor (Form AISD/Con), AISD’s Agreement for Construction between Owner and Construction Manager-at-Risk (Form AISD/Con-CMR), AISD’s Agreement Between Owner and Design/Build Contractor (AISD/Con-Design Build, hereinafter sometimes specifically referred to as a “Design/Build Agreement”) or AISD’s Job Order Contract between Owner and Contractor (Form AISD/Con-JOC), which incorporates each Task Order executed thereunder.
- B. “AISD” or “Owner” means the Austin Independent School District of Travis County, Texas.
- C. “Architect/Engineer” means the person or organization designated to perform the functions of Architect/Engineer or Project Architect, for this Contract, or in a separate writing signed by a Contracting Officer.
- D. “Change Order” means a written amendment to the contract mutually agreed to by the Owner and Contractor that is generally based on a Change Order Request.
- E. “Change Order Request” means a written document initiating a change in the Work.
- F. “Claim” means, as between the Owner and the Contractor, an assertion that the party making the claim is entitled, as a matter of right, to an adjustment in the Contract Amount, and/or the Contract Time, or is otherwise entitled to payment or damages. With regard to third persons, including subcontractors, a claim is an assertion of entitlement to payment or damages.
- G. “Contract” means the Contract Documents that form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Architect/Engineer and Contractor, or between the Owner and a subcontractor.
- H. “Contract Amount” or “Proposal” means the amount identified in the Contract as the sum of the Cost of the Work and the Contractor overhead and profit, subject to adjustment as provided in the Contract Documents. The term Contract Amount



shall have the same meaning as “Contract Sum” or “Contract Price.” In Contracts establishing a Guaranteed Maximum Price, the Contract Amount shall not exceed the Guaranteed Maximum Price.

- I. “Contract Documents” consist of the (i) Agreement, (ii) Special Conditions (if any), (iii) Supplemental Conditions (if any), (iv) Owner’s General Conditions of the Contract for Construction (“General Conditions”), (v) Owner’s Notice of Prevailing Wage Rates (the “Notice of Prevailing Wage Rates”), (vi) Drawings and Specifications, (vii) Owner’s Solicitation Documents and the Contractor’s response, to the extent not modified by the other Contract Documents, and any attachments and exhibits to any of the foregoing, and Modifications issued after execution of the Contract. In the event of a conflict between two or more of the Contract Documents, each shall prevail over the other in the order of preference listed above, unless otherwise provided by the terms of the Contract Documents. In the event of a conflict between the Drawings and the Specifications, the provisions of Section 1.2.B. shall apply.
- J. “Contract Time” means the time provided in the Contract Documents for Substantial Completion of the Work.
- K. “Contracting Officer” means a person authorized to bind Owner in matters relating to the Contract; specifically, the President of the Board of Trustees of AISD, the Superintendent of Schools of AISD, the Chief Financial Officer of AISD, the Executive Director of Facilities of AISD, the Executive Director of Construction Management of AISD, or such other person as may be authorized by resolution of the Board of Trustees of AISD to exercise the functions of a Contracting Officer for this Contract.
- L. The “Contractor” means “Contractor,” “Design/Build Contractor,” “Construction Manager-at-Risk,” “Proposer,” “Offeror,” or “Bidder” as identified in the Contract Documents.
- M. “Cost of the Work” shall mean the actual cost of all Work provided by Contractor under the Contract which is subject to payment or reimbursement by Owner, unless otherwise provided in the Agreement.
- N. “Day” means a calendar day unless the context indicates otherwise or the term “business day” is used. A business day shall mean weekdays but exclusive of Federal holidays.
- O. “Drawings” means the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams. The term “Drawings” does not include shop drawings.

- P. “Final Completion” means the date the Contract has been fully performed by the Contractor (except for the Contractor’s responsibility to correct defective or nonconforming Work, and to satisfy other requirements, if any, which necessarily survive final payment), and a final Certificate for Payment approved by the Owner has been issued by the Architect/Engineer.
- Q. “Modification” is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) an Interim Change Authorization, or (4) a written order for a minor change in the Work issued by the Architect/Engineer or Owner.
- R. “Person” means an individual, sole proprietorship, corporation, limited liability company, partnership, limited partnership, or other entity.
- S. “Personal property” means any property that is not real estate.
- T. “Preconstruction” or “Preconstruction Phase” means the period after execution of the Contract but prior to the commencement of construction.
- U. 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 or by separate contractors.
- V. The “Project Manual” is a volume assembled for the Work which may include the bidding requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.
- W. “Solicitation Documents” means the documents issued by Owner to solicit construction services, including the Request for Bids, Request for Competitive Sealed Proposals, Request for Qualifications, the Instructions, the Forms, any Drawings, Specifications or other documents or information referred to therein, and all Addenda.
- ~~X.~~ “Solicitation Process” means the process by which the Owner advertises for and selects the Contractor for the performance of services and the Work.
- Y. “Specifications” means that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.

- Z. “Subcontractors” are those persons or organizations having a contract with the Contractor or another subcontractor to (i) perform labor, (ii) supply materials or equipment, or (iii) fabricate materials or equipment off-site.
- AA. “Submittals” means shop drawings, product data, and samples as defined in Article 3, Section 3.7A and B herein, and any other documents or items required to be submitted by Contractor to Architect/Engineer or Owner under the terms of the Contract Documents or in connection with the Contract.
- BB. “Substantial Completion” is that stage of completion, short of final completion, at which the Work, or a discrete portion thereof, is usable by the Owner for the purpose for which it is intended (any necessary Certificate of Occupancy having been obtained), and at which, in order to obtain possession and control of the Work or the particular discrete portion, it is advantageous to the Owner to assume the burden of maintenance and risk of loss thereof.
- CC. The “Work” means the construction and services defined in the Agreement and required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services to be provided by the Contractor to fulfill the Contractor’s obligations and labor, materials, equipment and services provided or to be provided by subcontractors, sub-subcontractors, material suppliers, or any other entity for whom the Contractor is responsible under or pursuant to the Contract. The Work may constitute the whole or part of the Project.

Any terms used in the General Conditions which are not expressly defined herein, or in the other Contract Documents, or which do not have a specific meaning inferable from the context in which they are used, shall have the meanings normally ascribed to them in the construction industry, particularly as those terms are used and understood in Austin, Texas or in the location where the Work is performed.

## 1.2 CORRELATION AND INTENT

- A. 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 any one Contract Document shall be as binding as if required by all. Omissions from the Drawings or Specifications, or the misdescription of details of Work which are evidently necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the Work, but they shall be performed as if fully and correctly set forth and described in the Drawings and Specifications. Work not covered in the Contract Documents will not be required unless it is consistent therewith and is reasonably inferable therefrom as being necessary to produce the intended results. In the event Contractor has any questions or concerns regarding the Drawings or Specifications, or the completeness, adequacy or constructability of any of the

design documents, or if Contractor believes that there is an error or inconsistency in any of the design documents, Contractor shall notify Owner and Architect/Engineer as soon as possible, and shall request clarification or additional information from Architect/Engineer.

- B. In the case of an inconsistency between Drawings and Specifications, or within either document, and not clarified by addendum, or responses to requests for information, the better quality or greater quantity of Work described shall be provided in accordance with the Owner's interpretation.
- C. Organization of the Specifications and arrangement of Drawings shall not control the Contractor in dividing the Work among subcontractors or in establishing the extent of what is to be performed by any trade.
- D. Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.
- E. The Specifications and the accompanying Drawings are the property of Owner and shall be returned to Owner upon request at the completion of the Work. The Contractor may retain one record set.
- F. Time is of the essence in this Contract.

### 1.3 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

- A. The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect/Engineer and the Architect/Engineer's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. Neither the Contractor nor any subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants who shall be deemed the authors of them and will retain the rights provided in the Agreement between Owner and Architect/Engineer. All copies of Instruments of Service, except the Contractor's record set, shall be suitably accounted for to the Architect/Engineer and Owner, on request, upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants, and copies thereof furnished to the Contractor, are solely for use with respect to this Project. The Contractor, 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/Engineer and the Architect/Engineer'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/Engineer and the Architect/Engineer'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 the Architect/Engineer's or Architect/Engineer's consultants' copyrights or other reserved rights.

- B. Contractor shall restrict its Work to the designated areas of the Project site, and any other work areas which Contractor is permitted to use by Contract or lease. Contractor shall not trespass onto the property of any other person or conduct Work in areas prohibited by Owner. Contractor shall not permit vehicles, debris, materials or equipment to be placed or stored on the property of a third party or within public rights of way, unless Contractor has obtained a permit, license or other written permission to do so, or is otherwise complying with applicable law. In using easements or rights of way, Contractor shall conform to all applicable usage requirements established by law or the documents creating the easement or right of way.

## **2. Article 2. RESPONSIBILITIES OF THE ARCHITECT/ENGINEER**

### **2.1 OWNER/ARCHITECT/ENGINEER RELATIONSHIP**

- A. All formal communications from the Contractor to Owner in connection with the Contract shall be in writing addressed to the attention of the Owner's Contracting Officer, with a copy to Owner's designated project manager ("Owner's Project Manager"), shall reference the Contract by project name and number, and shall be transmitted in duplicate. Any or all of the Owner's formal communications to Contractor will be issued by the Owner or through the Architect/Engineer. In the case of a Design/Build Agreement, formal communications from the Contractor to Owner in connection with the Design/Build Agreement shall be in writing addressed to the attention of the Owner and the Owner's Contracting Officer, with a copy to Owner's Consultant.
- B. The Owner's Project Manager and Owner's Consultant do not have the authority to execute Change Orders or agree to changes in the Work which affect the Contract Amount or the Contract Time. These changes must be approved by the appropriate Contracting Officer.
- C. The Architect/Engineer shall advise and consult with the Owner as is necessary for the proper administration of the Project.
- D. The Contracting Officer may delegate any part of his respective functions hereunder, but the Contractor will be notified in writing of any such delegation and the extent thereof.

### **2.2 CONTRACT ADMINISTRATION**

- A. Architect/Engineer will perform all obligations under the Agreement between Owner and Architect/Engineer, including those set forth below. The Architect/Engineer will inspect the Work for general compliance with the Contract Documents. The Architect/Engineer will initiate Change Orders Requests and evaluate the Contractor's proposed cost and related time. The Architect/Engineer will conduct inspections required (a) to determine the date or dates of Substantial Completion and (2) for the final inspection in accordance with Section 8.4 of these General Conditions of the Contract. The Architect/Engineer will review, upon receipt from the Contractor, the as-built drawings, written warranties, owner's manuals and related documents required by the Contract. The Architect/Engineer will review requests for payment submitted by Contractor and will make recommendations to Owner on payment. In the case of a Design/Build Agreement, the parties' responsibilities will be governed by the Construction Contract Administration provisions contained within the Design/Build Agreement.

### **3. Article 3. RESPONSIBILITIES OF THE CONTRACTOR**

#### **3.1 SUPERVISION AND DUTY**

- A. Contractor will provide all labor, equipment, and materials necessary to perform the Work in accordance with the terms of the Contract Documents and will supervise the performance of such Work and perform the other obligations set out in the Contract Documents within the time periods provided therein. Contractor will perform all Work in a good and workmanlike manner, free from negligence and defects in labor and materials, and in conformance with all applicable federal, state and local laws and the Contract Documents. The Contractor shall give adequate attention to the faithful prosecution and completion of this Contract and shall keep on the Project site at all times, skilled subcontractors and laborers sufficient in number and expertise to perform the Work in accordance with the Contract Documents, and within the Contract Time. Contractor shall be responsible for the performance and services of all subcontractors, suppliers, and persons providing labor or materials for the Work in connection with the Contract, and the acts and omissions of such persons in the performance of the Work shall be deemed to be those of Contractor.
  
- B. The Owner will furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site to the extent provided in the Agreement or otherwise agreed to by Owner and Contractor in writing. Owner shall decide what surveys, soil analyses and other studies by consultants are to be performed in accordance with the Work and the scope of such consulting services and shall provide Contractor with the results of all such surveys, studies and analyses, provided however that Owner does not warrant or guarantee the accuracy or completeness of any information so provided. Contractor shall have the full responsibility for determining the location of all utilities. Contractor shall confirm the location of each utility shall excavate and dispose of each on-site utility and shall cap each off-site utility as required by the Work and as may be included in the Specifications. The Contractor shall make available the

results of any site investigation, test borings, analyses, studies or other tests conducted by, or in possession of the Contractor or any of its agents. The Contractor represents that it is generally familiar with the Project site. The Contractor shall exercise special care in executing subsurface work in proximity of known subsurface utilities, improvements and easements. Nothing in this subsection shall be read or construed as limiting the responsibilities of the Contractor or its subcontractors pursuant to the terms of these General Conditions, or under other terms of the Contract.

- C. Subject to Section 7.1.C hereof, the Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect/Engineer in the Architect/Engineer's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.
- D. Except as provided in the Contract Documents to the contrary, direct communications between Owner and Contractor that affect performance or administration of the Contract shall be made or confirmed in writing by Contractor with copies forwarded to Architect/Engineer.
- E. 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. 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 or may otherwise be objectionable, the Contractor shall give timely written notice to the Owner and Architect/Engineer and shall not proceed with that portion of the Work without further written instructions from the Architect/Engineer. If the Contractor is then instructed by Owner 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 to Owner for any resulting loss or damage unless caused by the negligence or intentional misconduct of Contractor or persons performing Work under the Contract.
- F. 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.
- G. 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.

- H. All employees and subcontractors of the Contractor shall be qualified by training and experience to perform their assigned tasks. The Contractor shall not use in the performance of the Work or permit to be used any employee or subcontractor who is incompetent, careless, or unqualified to perform the Work assigned to it. Contractor shall engage sufficient workers on the Project at all times to perform the Work in a good and workmanlike manner and in the time periods required by the Contract Documents.
- I. The Contractor agrees that in the performance of the Work called for by this Contract, it will employ only such labor, and engage subcontractors that employ only such labor, with the requisite skills, expertise and experience to perform the Work required of such persons in a good and workmanlike manner, and who will not delay or interfere with the lawful progress of the Project within the Contract Time, and will be acceptable to and work in harmony with all other workers employed on the Project site or on any other building, structure or other improvement which the Contractor or any other contractors may then be erecting or altering on behalf of Owner.
- J. In the event of a strike or stoppage of work resulting from a dispute involving or affecting the labor employed by the Contractor or any of its subcontractors, Owner, at its option and without demand, may terminate the Contract for convenience unless the Contractor shall remedy the strike or work stoppage or other disruption within twenty (20) calendar days after the dispute arises.
- K. Contractor shall furnish Owner, on request, resumes of Contractor's key personnel involved in the day-to-day Work on the Project.
- L. Contractor will not permit at any time alcohol, controlled substances or firearms to be present at the Project site. No smoking will be permitted in any area of the Project which is enclosed or in the finish-out stage of construction.
- M. Lot lines and permanent benchmarks have been established as shown on the Drawings. The Contractor shall be solely responsible for properly laying out the Work and the Project unless there are errors not reasonably discoverable by Contractor, and for all lines, elevations and measurements for all of the Work executed under the Contract Documents. Contractor shall verify the figures shown on the Drawings before laying out the Work and will be held responsible for all costs resulting from its failure to do so.
- N. The Contractor has the responsibility to ensure that all material suppliers and subcontractors, their agents, and employees adhere to the Contract Documents, and that they order materials on time, taking into account the current market and delivery conditions



and times and that they provide materials on time. The Contractor shall coordinate its Work with that of all other persons or entities performing Work on the Project including deliveries, storage, installations and construction utilities. The Contractor shall be responsible for the space requirements, locations, and routing of all materials and equipment required under the Contract Documents. In areas and locations where the proper and most effective space requirements, locations, and routing cannot be made as indicated, the Contractor shall meet with all others involved, before installation, to plan the most effective and efficient method of overall installation.

- O. The Contractor shall employ at the Project site at all times during the progress of the Work a competent, English-speaking project manager (“Contractor’s Project Manager”), a competent, English-speaking superintendent (“Superintendent”) and any necessary English-speaking assistants to supervise and direct the Work. The list of all supervisory personnel, including the Contractor’s Project Manager and Superintendent, that the Contractor intends to use on the Project and a chain-of-command organizational chart shall be submitted to the Owner and Architect/Engineer for approval. The Contractor shall not engage supervisory personnel or utilize an organizational structure and chain-of-command other than as approved by Owner and Architect/Engineer, and shall not change such form or organizational structure without the written approval of the Owner and Architect/Engineer. The Contractor’s Project Manager or Superintendent shall represent the Contractor in Contractor’s absence and all communications given to the Contractor’s Project Manager or Superintendent shall be as binding as if given to the Contractor. The Contractor shall not remove an approved Superintendent from the Work without written, timely notice to Owner of such Superintendent’s removal and the proposed replacement having been approved by the Architect/Engineer and Owner. Owner and Architect/Engineer shall have the right to reasonably require Contractor to remove from the Project any Superintendent or on-site supervisor whose performance is not reasonably satisfactory to Owner and Architect/Engineer and replace such Superintendent or on-site supervisor with a Superintendent or on-site supervisor satisfactory to Owner and Architect/Engineer.
  
- P. The Contractor shall provide the Owner and Architect/Engineer access to the Work in preparation and progress wherever located at all times.

### 3.2 CONDITIONS AFFECTING THE WORK

- A. In agreeing to perform the Work within the Contract Time and for the Contract Amount as set forth in the Contract, including any Contract Time and Guaranteed Maximum Price established by amendment to a Construction Manager-at-Risk Contract, Contractor acknowledges, represents and warrants to Owner that it has thoroughly reviewed all of the Contract Documents, and has visited and examined the site as to visible surface conditions or conditions ascertainable from the results of any subsurface tests or information provided in connection with the Project, the

Contract Documents, and reasonably examined all legal, physical, and other conditions affecting the Work, including without limitation, all soil, subsurface, water, survey and engineering reports and studies delivered to or obtained by the Contractor in connection therewith. Contractor specifically warrants and represents to the Owner that it has by such careful examination of such information and based thereon, satisfied itself as to: (1) the nature, location, and character of the Project and the Project site; (2) the nature, location, and character of the general area in which the Project is located; (3) the conditions prevailing at the Project site, including climactic and weather conditions that are normal for the area, and those that are currently prevailing at the Project site; (4) anticipated labor supply and costs; (5) sufficiency and completeness of the Contract Documents, including the Drawings and Specifications, and the (6) availability and costs of labor, materials, supplies, professional services and equipment, in order to complete the Work in accordance with the Contract Documents, within the Contract Time and for not more than the Contract Amount. Contractor represents that all subcontractors engaged or to be engaged in the performance of the Work will be familiar with the requirements for performance by them of their obligations. The Owner shall not be obligated to make any adjustment in the Contract Time, Contract Amount and/or Guaranteed Maximum Price (if any) set out in the Contract, due to any failure by the Contractor to perform any of the foregoing examinations or determinations, or any miscalculation or misestimate of Contractor, or any subcontractor or supplier in connection therewith.

- B. Since the Contract Documents are complementary, before starting each portion of the Work, the Contractor shall carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to the Contract, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions at the Project site affecting it. The Contractor shall notify the Architect/Engineer of materials, systems, procedures or methods of construction, either shown on the Drawings or Specifications, that it believes are incorrect, inadequate, obsolete, unsuitable for the purpose intended, or which could have an adverse effect upon installation or completion by others under separate contracts. These services shall be performed during the Preconstruction Phase to the greatest extent possible, but in any event before the commencement of Work affected by such matters. Any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Architect/Engineer and Owner as a request for information in the form as the Architect/Engineer and Owner may require. Any design errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect/Engineer and Owner, 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/Engineer

and Owner. All notifications required by this Section 3.2 shall be given no later than five (5) days after Contractor first becomes aware of the problem. If the Contractor fails to perform its obligations under this Section, or performs Work that it reasonably should have known to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect/Engineer and Owner, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction. In addition, if the Contractor fails to perform the obligations as provided in Subsections B and C, Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.

- C. If the Contractor believes that additional cost or time is involved in the Work because of matters noted during the Construction Phase which could not reasonably have been detected by the Contractor during the Preconstruction Phase, or because of clarifications or instructions issued by the Architect/Engineer as a result thereof, the Contractor shall promptly notify Architect/Engineer and Owner in writing as soon as possible after Contractor becomes aware of the need for additional time or cost, but in no event later than five (5) days thereafter, and shall subsequently make a request for Change Order as provided in this Contract in order to be entitled to additional compensation or an extension of the Contract Time. Contractor shall not be entitled to any additional time or compensation for matters that it should have reasonably noted during the Preconstruction Phase, particularly where Contractor has performed Preconstruction Services for Owner as a Construction Manager-at-Risk. If Contractor's claim for additional time or additional cost is approved by Owner, the Contract Time and/or Contract Amount shall be equitably adjusted by Change Order.
- D. Any provision in the Contract Documents to the contrary notwithstanding, nothing in Sections 3.2 B and C shall reduce, diminish, limit or relieve Contractor from its obligations, representations and warranties contained in Section 3.2.A, and the Agreement.

### 3.3 DIFFERING SITE CONDITIONS

- A. The Contractor shall promptly, and before such conditions are disturbed, notify the Owner in writing of:
  - 1. Subsurface or latent physical conditions at the Work site differing materially from those indicated in the Contract Documents, or
  - 2. Unknown physical conditions at the Work site, of an unusual nature, differing materially from those which could reasonably be anticipated to be encountered at the Project site or generally recognized as inherent in work of the character provided for in the Contract Documents.

Notice must be given to Owner as soon as possible, but in no event later than 5 days after Contractor first becomes aware of the condition.

- B. The Owner and/or the Architect/Engineer shall promptly investigate the conditions, and if the Owner finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the Work under the Contract, an equitable adjustment shall be made and the Contract shall be modified by Change Order accordingly.
- C. No claim of the Contractor under this Section 3.3 shall be allowed unless the Contractor shall have given the notice required in Section 3.3.A above.

### 3.4 PERMITS, FEES, AND RESPONSIBILITIES

- A. The Contractor shall, at Contractor's expense as part of the cost of the Work, be responsible for obtaining all necessary licenses, fees, and permits, and for complying with any applicable Federal, State and municipal laws, codes and regulations, in connection with the prosecution of the Work. Contractor shall take proper safety and health precautions to protect the workers, the public, the Work and the property of others. Contractor shall be responsible for all materials delivered and work performed until final completion and acceptance of the entire Work.
- B. The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities applicable to the performance of the Work.

### 3.5 PATENTS, COPYRIGHTS, AND LICENSES

- A. The Contractor shall be responsible for obtaining all consents and licenses required to perform the Work, and to pay all royalties and license fees arising in connection with the Work performed under the Contract Documents.
- B. The Contractor will defend suits or claims for infringement of intellectual property rights, patent rights, or breach of license agreements, and indemnify Owner, the Architect/Engineer and their respective officers, members of their governing body, agents and employees against all liability, loss and expense (including attorneys' fees) for such alleged infringement or breach arising out of the performance of the Contract, or out of the use or disposal by or for the account of Owner of supplies furnished, or construction Work performed under the Construction Documents. These obligations are in addition to any other indemnification obligations provided by the Contract Documents and shall survive termination of the Contract or completion of Contractor's obligations under the Contract as to events occurring prior to such termination or completion.

### 3.6 CONSTRUCTION SCHEDULE

- A. The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect/Engineer's review and approval a Contractor's Construction Schedule for the Work ("Construction Schedule") meeting the requirements set forth in this Section. In no event shall the Construction Schedule be submitted later than the time the Contractor submits its first Estimate for Partial Payment.
- B. The Construction Schedule shall show the dates for starting and completing the various component activities making up the Work, and the logical relationships between them, and shall be in a format and in sufficient detail to permit the Work to be competently managed and its progress monitored. The level of detail shall be appropriate to the complexity of the Project and as directed by Owner, and both the level of detail and the terminology used to describe the components must align with the Contractor's Schedule of Values. The Construction Schedule shall take account of the time required for the preparation and review of required Shop Drawings and other submittals and the time periods provided in the Contract Documents for review and approval of submissions by Architect Engineer and/or Owner. The Contractor shall utilize Microsoft Project scheduling program software or other scheduling program software as approved by Owner and shall employ the Critical Path Method ("CPM") of scheduling to develop the network logic diagrams, computer-produced schedules, and other schedule supporting data as required. The Contractor shall use the CPM schedule to plan, coordinate and manage all construction activities of the subcontractors.
- C. The Construction Schedule shall be related to the entire Project, including the time period necessary for equipment, furnishings and other materials or work to be provided by Owner through its employees or through separate contracts to be performed, and shall provide for Substantial Completion of all of the Work within the Contract Time.
- D. In performing the Work, the Contractor shall comply with the most recent approved Construction Schedule. Contractor shall submit updated schedules monthly thereafter for the review and approval of the Architect/Engineer and Owner with each Estimate for Partial Payment, or more frequently if the schedule is impacted by events occurring in connection with the Work. Such submittal is a condition to Owner's obligation to make progress or other payments to Contractor under the Contract. The effect of all Change Orders and the onset of any adverse weather conditions or other events which impact the Construction Schedule or which are cited by Contractor as the basis for a request for a time extension shall be duly noted on the updated Construction Schedule and their effect on the Construction Schedule and the critical path shown. Failure to comply with this requirement may result in a denial of the Contractor's request or claim for an extension of time due to such delays. Contractor shall promptly notify Architect/Engineer and Owner as soon as it becomes aware that the Work is lagging behind the time frame shown on the latest approved Construction Schedule, regardless of the cause for such delay, and will notify them of the action that Contractor recommends or will take in order to bring the Project back on schedule, including, but not limited to, acceleration of the Work in accordance with the provisions of the Contract Documents.

- E. Submittal of the Construction Schedule, and successive updates or revisions, is for the information of the Owner and Architect/Engineer, to allow them to monitor progress and to permit the coordination of their activities with those of the Contractor. Owner and Architect/Engineer shall accept or reject the submittal of a schedule within the same period allowed for review of other submittals, or if no time period is expressly provided, within a reasonable time after receipt. Acceptance of a Construction Schedule, schedule update or revision indicating a completion prior to the end of the Contract Time does not give rise to an acceleration or delay claim by the Contractor for any time outside of the schedule but included in the Contract Time. Similarly, the Owner's acceptance of a Construction Schedule, update or revision, that depicts an event which Contractor asserts as the basis for a delay claim, or a request for a time extension or cost increase, does not constitute an agreement by Owner to such request or claim, and does not relieve the Contractor from pursuing the procedure for requesting a Change Order, time extension or claim for delay set forth in the Contract Documents. Acceptance of a Construction Schedule, update or revision does not indicate the approval by the Owner or Architect/Engineer of the Contractor's proposed sequences and duration. Acceptance of a Construction Schedule update or revision indicating late completion does not constitute the Owner's consent to a late finish, or waive either the Contractor's responsibility for timely completion or the Owner's rights and remedies for the Contractor's failure to do so.
  
- F. The Contractor shall prepare and keep current, for the Architect/Engineer's approval, a separate schedule of submittals which is coordinated with the Contractor's Construction Schedule and allows the Architect/Engineer and/or Owner reasonable time to review submittals. It is understood and agreed that in establishing a reasonable time period for review of any submittals or requests, Owner shall be allowed a sufficient time period to submit any matter requiring Board approval to the AISD Board of Trustees at a regularly scheduled Board meeting.

### 3.7 SUBMITTALS

- A. "Shop Drawings" means drawings, diagrams, schedules, and other data, which are prepared for the Work by the Contractor or any subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work. "Product Data" means 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.
  
- B. "Samples" means physical examples furnished by the Contractor to illustrate materials, equipment or workmanship, and to assist in the establishment of standards by which the Work will be judged.
  
- C. The Contractor shall review and designate (stamp) its approval and submit, with reasonable promptness and in orderly sequence, all Shop Drawings, Product Data and Samples required by the Contract Documents, or subsequently by the Owner

and/or Architect/Engineer as covered by a Change Order or Construction Change Directive.

- D. Shop Drawings, Product Data and Samples shall be properly identified, as specified, or as the Architect/Engineer may require. At the time of submission, the Contractor shall inform the Architect/Engineer in writing of any deviation in the Shop Drawings, Product Data or Samples from the requirements of the Work and of the Contract Documents.
- E. By approving and submitting Shop Drawings, Product Data and Samples, the Contractor thereby represents that Contractor has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that Contractor has checked and coordinated each Shop Drawing, Product Data and Sample with the requirements of the Work and of the Contract Documents.
- F. The Contractor shall submit to the Architect/Engineer, with such promptness as to cause no delay in the Work or in the activities of the Owner or of separate contractors, the number of Contractor-approved copies of Shop Drawings, Product Data and Samples required for the Owner's, Architect/Engineer's and Contractor's use. The review by the Architect/Engineer of the Shop Drawings, Product Data or Samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the Architect/Engineer in writing of such deviation at the time of submission and the Architect/Engineer has given written approval to the specific deviation, nor shall the review of the Architect/Engineer relieve the Contractor from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples.
- G. The Contractor shall make any corrections required by the Architect/Engineer and shall resubmit the required number of corrected copies of the Shop Drawings, Product Data or new Samples of materials until approved. The Contractor shall direct specific attention in writing to any new revisions other than the corrections requested by the Architect/Engineer on previous submissions. In the event Contractor resubmits Shop Drawings, Product Data or Samples of materials more than one time because not previously approved, and Architect/Engineer charges Owner for Additional Services for such multiple reviews under the provisions of the Agreement between Owner and Architect/Engineer, Contractor shall be responsible for paying for, or reimbursing Owner for, the cost of such Additional Services.
- H. No work requiring a Shop Drawing, Product Data or Sample submittal shall be commenced until the submittal has been reviewed and approved by the Architect/Engineer. All such Work shall be in accordance with reviewed and approved Shop Drawings, Product Data and Samples.

- I. The Contractor shall maintain at the site office for the Owner and Architect/Engineer, one copy of all reviewed Shop Drawings, Product Data, Samples and similar required submittals. These shall be delivered to the Architect/Engineer for submittal to the Owner upon completion of the Work.
- J. The Contractor shall submit all requests for information to the Architect/Engineer for resolution.
- K. The Contractor shall maintain at the Project site for the Owner one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record field changes and selections made during construction, and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect/Engineer and shall be delivered to the Architect/Engineer for submittal to the Owner upon completion of the Work as provided in Section 3.9, signed by the Contractor, certifying that they show complete and “as-built” conditions, stating sizes, kind of materials, vital piping, conduit locations and similar matters.

### 3.8 MATERIALS AND WORKMANSHIP

- A. Contractor warrants that all materials and labor provided under this Contract shall be installed and performed in a good and workmanlike manner in accordance with the Contract Documents, and shall be free from defects and deficiencies.
- B. Unless otherwise specifically provided in the Contract, all equipment, material, and articles incorporated in the Work covered by the Contract shall be new and of the most suitable grade for the purpose intended. The Contractor shall furnish to the Architect/Engineer for its approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature, and rating of the machinery and mechanical and other equipment that the Contractor contemplates incorporating into the Work. When required by the Contract or when called for by the Owner or Architect/Engineer, the Contractor shall furnish the Architect/Engineer, for approval, full information concerning the material or articles the Contractor contemplates incorporating into the Work. When so directed by Owner or Architect/Engineer, samples shall be submitted for approval at the Contractor’s expense, with all shipping charges prepaid. Machinery, equipment, materials, and articles installed or used without required approval shall be at the risk of subsequent rejection.
- C. Architect/Engineer shall not call for lead based paint or asbestos containing materials to be used in connection with the Project. No lead based paint and no materials containing asbestos shall be incorporated into the Project. Contractor, subcontractors, and suppliers may be required to certify that these materials were not provided or installed as part of this Contract.



- D. All Work under the Contract shall be performed in a skillful and workmanlike manner. The Owner may, in writing, require the Contractor to remove from the Work any person the Owner deems incompetent, careless, or otherwise objectionable.
- E. Neither custom nor usage of trade shall require Owner to accept materials or workmanship not in strict and complete compliance with the Contract Documents.
- F. Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, electricity and other 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 into the Work.
- G. Should the Contract Documents require Work to be performed after regular working hours or should the Contractor elect to perform work after regular working hours, the additional cost of such Work shall be borne by the Contractor as part of the Contract Amount.
- H. Should the Owner, through no default of Contractor, desire to reduce the Contract Time and authorize overtime, the additional cost (premium portion only) shall be paid by the Owner and the Contract Amount shall be adjusted accordingly, only if such work is authorized in writing by the Owner as a Change Order prior to performance.
- I. The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them, or who are disorderly or who fail to observe Owner's rules for Work on the Project site.
- J. The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.
- K. The Contractor shall not damage or endanger a portion of the Work of fully or partially completed construction of the Owner or separate contractors including damage or endangerment 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. Structural members shall not be cut except with written permission of the Architect/Engineer. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

- L. After installation of the Work, Contractor shall carefully fit around, close up, repair, patch and point up such Work to match adjoining surfaces by use of proper tools and materials using workers skilled in the required trades.

### 3.9 AS-BUILT DRAWINGS

- A. During the performance of Work under the Contract, the Contractor shall record and delineate accurately on one set of prints of the Drawings, which will be furnished to Contractor by the Architect/Engineer, all changes in such Work which constitute significant departures from the original Drawings. The set of Drawings thus corrected and changed shall show the Work as actually constructed (“As-Built Drawings”). Such As-Built Drawings shall be delivered to the Architect/Engineer for review and approval at the earliest practicable date prior to completion of all Work under the Contract, but in any event not later than the date of final acceptance of the completed Work.
- B. The Contractor shall review said As-Built Drawings on site with the Architect/Engineer at monthly intervals to verify proper recording of data and shall incorporate such revised Drawings as may be furnished by the Architect/Engineer as the job progresses.
- C. The As-Built Drawings shall show sufficient detail to convey, among other pertinent information, the following:
  - 1. Physical dimensions, relation to existing conditions, and horizontal and vertical location of all underground or hidden installations; and
  - 2. All modifications to the Work as recorded in Change Orders.
- D. With the As-Built Drawings, Contractor shall submit manufacturers’ literature, including service manuals, schematic diagrams, control diagrams, maintenance charts, parts lists, etc., as required to provide complete equipment operation and maintenance information.

### 3.10 CLEANUP

- A. The Contractor shall keep the Project site and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract, and shall establish a regular maintenance program to minimize accumulation of dirt and dust. Contractor shall promptly remove any dirt or debris resulting from the Work which is on adjacent streets and shall with the consent of adjoining landowners, remove such dirt or debris from adjoining properties.
- B. At Substantial Completion, all interior floors shall be cleaned in accordance with Owner’s directions, carpets shall be vacuumed, glass in doors and windows shall be cleaned, countertops, cabinets and other surfaces shall be free from debris, dirt and dust, landscaping

shall be neat and plants and grass installed as part of the Work shall be healthy and in good condition, and exterior surfaces and walkways shall be free from dirt and debris. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

- C. Upon completion of the Work and before acceptance and final payment will be made, the Contractor shall clean and remove from the Work site all surplus and discarded materials, temporary structures and debris of every kind. Surplus and waste materials removed from the Work site shall be disposed of in accordance with applicable laws and regulations. The Contractor shall remove from and about the Project site the Contractor's tools, construction equipment and machinery, and all spillage and tracking arising from the performance of the Work from such areas.
- D. If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the Project site and surrounding area free from waste materials and rubbish, the Owner may clean up and allocate the cost among those responsible.

### 3.11 WARRANTIES

- A. In addition to all other warranties provided in or pursuant to the Contract Documents, and without limitation or restriction on the rights and remedies of Owner arising in connection with the obligations of the Contractor under the Contract Documents, the Contractor warrants the materials, workmanship and Work to be in conformance with the Contract Documents and to be free from defects in materials and workmanship for a period of one year. Unless (i) the terms of the Contract Documents call for the warranty period to begin at final completion, (ii) Owner expressly agrees to a warranty period for a component of the Work which runs from the date of Substantial Completion of the component, (iii) otherwise provided in the Contract Documents, (iv) otherwise agreed to by Owner and Contractor in writing, or (v) otherwise provided in Architect's Certificate of Substantial Completion for certain punch list items pursuant to Section 8.3.A hereof, the warranty provided by this Subsection 3.11.A will be deemed to run from the date of Substantial Completion of the Work as documented by the Architect/Engineer pursuant to the terms of the Contract. The warranty described herein binds the Contractor to repair or replace (at the option of Architect/Engineer or Owner) without cost to Owner, any Work that is out of compliance with the Contract Documents and any Work which during the one-year period described herein exhibits defects in workmanship or materials or which malfunctions or fails to work correctly or in the manner intended. The Contractor shall, at Contractor's own expense, correct any such defect or deficiency no later than thirty days after receiving written notice of such defect from the Owner or Architect/Engineer, or within such shorter period of time as Owner or Architect/Engineer may reasonably request. Contractor shall be obligated as part of its warranty obligation, to repair or replace any other portion of the Work damaged or destroyed by (i) the non-

complying, malfunctioning or defective Work, or (ii) the process of repairing or replacing the non-complying, malfunctioning or defective Work. The warranty provided herein will be extended by any work performed by the Contractor (or performed by the Owner or Surety in the event Contractor fails to perform its warranty obligations) in repairing or replacing non-complying, malfunctioning or defective work or materials, so that all repaired or replaced work shall have, in addition to any manufacturer's warranty, a one-year warranty from Contractor from the date repairs or replacements are completed. In the event Contractor fails to comply with these provisions, Owner shall have, in addition to any other rights and remedies provided by law or the Contract Documents, the right to (i) perform the repair or replacement by its own employees or other contractor and demand reimbursement from Contractor for all amounts incurred by Owner, in which event Contractor shall pay said amounts to Owner within 30 days after demand, and/or (ii) make demand on Surety to perform Contractor's obligations. The Contractor's warranty excludes remedy for damage or defect caused by Owner's abuse, modifications not executed by the Contractor except as authorized herein, improper or insufficient maintenance by Owner, improper operation by Owner, or normal wear and tear and normal usage. If required by the Architect/Engineer or Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment used in the Work.

- B. Work not conforming to Contract requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor shall perform all work reasonably required to correct Work with errors, omissions, defects or deviations from what is required by the Contract Documents, at no cost to the Owner.
  
- C. All warranties required by the Contract Documents shall include labor and materials and shall be signed by the manufacturer and/or subcontractor as the case may be and countersigned by the Contractor. All warranties shall be delivered to the Architect/Engineer upon completion of the Work and before the submission of Contractor's Final Estimate for Partial Payment. At the time of final completion of the Work, the Contractor agrees to assign to the Owner any and all manufacturers' warranties relating to materials and labor used in the Work and further agrees to perform the Work in such manner so as to preserve any and all such manufacturers' warranties.
  
- D. In addition to the foregoing stipulations, the Contractor shall comply with all other warranties referred to in any portions of the Contract Documents, and where warranties overlap, the more stringent requirement shall govern.
  
- E. The Contractor represents, warrants and covenants to the Owner that it is fully authorized and qualified to enter into the Contract and that if all or any portion of the Work is required by law or by the Contract Documents to be performed by persons with special or specific licensure, certifications, training or qualifications, the employees and/or subcontractors

selected to perform such Work shall be, and shall remain, fully licensed, certified, trained and qualified to perform such Work throughout the term of the Contract. Contractor will provide evidence of the same to the Owner upon request.

- F. The provisions of this Section 3.11 shall survive the termination of this Contract, howsoever caused, and no partial payment, or final payment by Owner, nor issuance of a certificate of Substantial Completion nor a certificate of final completion, nor acceptance of occupancy in whole or in part of the Work shall waive or release any of the provisions of this section or constitute an acceptance of defective Work or Work which does not comply with the Contract Documents.
- G. In the event items on the punch list (as defined in Section 8.3 below) at Substantial Completion are not completed within the period fixed by Architect/Engineer in the Certificate of Substantial Completion pursuant to Section 8.3.A hereof, the warranty on those items shall commence on the date of final acceptance of the Work or completion of those items to the reasonable satisfaction of Architect/Engineer and Owner, whichever is later.

### 3.12 INDEMNIFICATION

- A. To the fullest extent permitted by applicable law, the Contractor agrees to indemnify, defend and hold harmless Owner, its officers, trustees, agents, employees, and representatives from and against any liability, damages, costs, loss, expenses, claims, actions, proceedings, suits (including attorneys' fees, court costs and other expenses of suit), whether groundless or not, judgments and awards, arising out of, in connection with or related to the performance of Work by Contractor, its employees, any subcontractor, or other person performing services or work on behalf of any of them, including a default by Contractor under the provisions of the Contract Documents or a failure to obtain or maintain insurance required by the Contract Documents. This indemnification shall apply to, but not be limited to, any damage to property or injury (including death) to person (including any damage or injury to property or person or any employee of the Contractor, its subcontractors, Owner, or the Architect/Engineer) which may occur or be alleged to have occurred in connection with the performance of this Contract. Contractor shall not be obligated to indemnify any of the indemnified parties against their own negligence; **however, to the fullest extent permitted by applicable law, Contractor shall be required to defend the indemnified parties against liability, damages, costs, loss, expenses, claims, actions, proceedings, or suits (including attorneys' fees, court costs and other expenses of suit), whether groundless or not, for the bodily injury or death of an employee of the Contractor, its agent or its subcontractor of any tier, regardless of whether the action giving rise to such liability, damages, costs, loss, expenses, claim, action, proceeding or suit (including attorneys' fees, court costs and other expenses of suit), is founded in whole or in part upon the alleged negligence of one or more parties indemnified hereunder.** The Contractor assumes all risk of damage or

injury (including death) to the Contractor's own property or person or to the property or person of the Contractor's employees or subcontractors from any cause whatsoever. This indemnification shall survive termination of the Contract or completion by the Contractor of all of its obligations under this Contract, as to events arising prior to such termination or completion.

- B. In claims against any person or entity indemnified under this Section 3.12 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 this section shall not be limited by a limitation on amount or type of damages, insurance, compensation or benefits payable by or for the Contractor or a subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.
- C. The provisions of this indemnification and all other indemnification obligations set out in the Contract Documents, shall survive the termination of this Contract, howsoever caused, or completion of the Contract as to events occurring prior to such termination or completion, and no payment, partial payment, nor issuance of a certificate of Substantial Completion nor a certificate of Final Completion nor acceptance or occupancy in whole or in part of the Work shall waive or release any of the provisions of this section or of any other indemnification contained in the Contract Documents.

### 3.13 REPARATIONS FOR DAMAGED PROPERTY, IMPROVEMENTS AND WORK

- A. Should the Contractor cause damage to the property or improvements of the Owner or the work of any separate contractor to the Owner, or to the property of any third party, Contractor shall, upon due written notice by the Owner, separate contractor, or third party, make timely reparations acceptable to the damaged party or parties.

### 3.14 SUBSTITUTIONS OF MATERIALS OR EQUIPMENT

- A. The Owner may refuse to accept substitutions of materials or equipment which were not requested by the Contractor and approved by Owner during the Solicitation Process.
- B. Owner may, in its discretion, agree to accept substitutions of materials or equipment after the Contract has been signed for good cause shown. The Contractor may make substitutions of materials or equipment only with the prior written consent of Owner after evaluation and approval by the Architect/Engineer and in accordance with a Change Order. A request for substitution constitutes a representation by Contractor that Contractor:
  - 1. has investigated the proposed product and determined that it is equal or superior in all respects to the specified product;

2. shall provide identical warranties as those required for the specified product or any extended warranties required by Owner as a condition for approval of the substitution;
3. shall coordinate installation and make changes to other Work which may be required at no cost to Owner;
4. waives claims for additional costs or time extension which may subsequently become apparent;
5. certifies that the proposed product will not affect or delay the approved Construction Schedule; and
6. shall pay for changes to the design of the building, Work, or any components thereof, including architectural or engineering design, detailing and construction costs caused by or resulting from the requested substitution.

### 3.15 CRIMINAL HISTORY RECORD INFORMATION REVIEW AND IDENTIFICATION BADGES FOR COVERED EMPLOYEES

Contractor shall, at its sole cost and expense, comply and cause each subcontractor to comply with the provisions of this Section 3.15 and all provisions of Texas Education Code (“TEC”) §22.08341 regarding criminal history record information review and issuance of identification badges for all covered employees (hereafter defined) in connection with the Work. Contractor’s failure to comply with any of the terms and conditions of this Section 3.15 shall be a material default under the Contract.

- A. As used herein, the term “covered employee” shall mean an individual employed by or offered employment by Contractor or a subcontractor, or an individual subcontractor, who (i) has or will have continuing duties on the Project site related to the services to be performed in connection with the Work, and (ii) has or will have the opportunity for direct contact with students in connection with the individual’s continuing duties in connection with the Work. An individual does *not* have the opportunity for direct contact with students only if the appropriate conditions of TEC §22.08341(c) are satisfied. If the Solicitation Documents state that Texas Education Code (“TEC”) §22.08341 is applicable to workers, or if at any time during the Work it is determined by Owner that some or all of the workers on the Project are covered employees, Contractor and each affected subcontractor shall comply with this Section 3.15 with regard to their respective workers who are covered employees. If an individual employed by or offered employment by Contractor is not a covered employee, the Contractor shall make a reasonable effort to ensure that the conditions or precautions that resulted in that determination continue to exist throughout the time the contracted services are provided.

- B. In accordance with TEC §22.08341, Contractor shall, at its sole cost and expense: (i) send or ensure that the individual sends to the Department of Public Safety information that is required for obtaining national criminal history record information in accordance with TEC §22.08341, and (ii) obtain with regard to its covered employees and cause each subcontractor, at its sole cost and expense, to obtain with regard to its covered employees, the criminal history record information as required by TEC §22.08341 for each such covered employee,. **[Contact the Texas Department of Public Safety Crime Records Service at (512) 424-5079 for instructions on obtaining national criminal history record information.]**
- C. Contractor shall not assign to, permit, or allow on the Project site any covered employee who has a disqualifying criminal history. A covered employee has a “disqualifying criminal history” under this Section 3.15 if the covered employee has been convicted of one of the following offenses or crimes during the preceding 30 years and the victim was under 18 years of age or was enrolled in a public school: (i) a felony offense under Title 5 of the Texas Penal Code; (ii) an offense on conviction of which a defendant is required to register as a sex offender under Chapter 62 of the Texas Code of Criminal Procedure; (iii) an offense or crime (whether a felony or a misdemeanor) involving moral turpitude, including without limitation theft, bribery, fraud, perjury, sexual offenses, or offenses involving intentional acts of violence toward persons or property; or (iv) an offense under the laws of another state or federal law that is equivalent to an offense under (i), (ii) or (iii) above. Provided, however, Contractor or a subcontractor may assign to, permit or allow a covered employee on the Project site if the only convictions reported on the criminal history record information are crimes involving only misdemeanor theft offenses (other than theft of school district funds or property) occurring more than seven (7) years prior to the date the worker would commence work on the Project.
- D. Contractor shall maintain at all times a list of all covered employees on the Project (as updated from time to time by Contractor, the “List of Covered Employees”) which contains the following information for each covered employee: (i) full name; (ii) whether, in accordance with the applicable requirements of TEC §22.0834, national or state criminal history record information was obtained; (iii) the full name of the covered employee’s employer, if applicable; and (iv) Texas driver’s license or other identification number or such other information as Owner may request from time to time to enable Owner to obtain criminal history record information for the covered employee. The covered employees on the List of Covered Employees shall be grouped by employer.
- E. Prior to commencement of the Work, Contractor shall deliver to Owner, or its designee if directed by Owner:
- (a) an electronic copy in PDF format of the initial List of Covered Employees for all covered employees on the Project; and



(b) an electronic copy in PDF format of Contractor's duly completed and executed certification on a form provided by Owner ("Contractor Certification") by the terms of which Contractor certifies to Owner that

(i) all information on the List of Covered Employees is true and correct in all respects;

(ii) Contractor has obtained (with respect to its covered employees) and has caused to be obtained (with respect to all other covered employees on the Project) all required criminal history record information relating to each covered employee on the List of Covered Employees in accordance with TEC §22.08341;

(iii) each subcontractor providing any part of the Work, contracting directly with Contractor (each a "First Tier Subcontractor"), has duly completed and executed a First Tier Subcontractor Certification (hereafter defined) and each First Tier Subcontractor Certification is attached to the Contractor Certification;

(iv) each Sub-subcontractor (hereafter defined) on the Project has provided a duly completed and executed Sub-subcontractor Certification (hereafter defined) to the appropriate First Tier Subcontractor in accordance with these General Conditions; and

(v) none of the covered employees on the List of Covered Employees has a disqualifying criminal history under this Section 3.15. If it is determined that any statement in any Contractor Certification, First Tier Subcontractor Certification or Sub-subcontractor Certification is untrue or misrepresented when made, Contractor shall be in material default under the Contract.

F. As used herein, "First Tier Subcontractor Certification" shall mean a duly completed and executed certification on a form provided by Owner by the terms of which First Tier Subcontractor certifies to Owner and Contractor that (i) all of the covered employees employed by First Tier Subcontractor on the Project are included on the List of Covered Employees and properly identified as employees of First Tier Subcontractor; (ii) all information on the List of Covered Employees with respect to the covered employees employed by First Tier Subcontractor is true and correct in all respects; (iii) First Tier Subcontractor has obtained all required criminal history record information relating to each covered employee of First Tier Subcontractor on the List of Covered Employees in accordance with TEC §22.08341; (iv) none of the covered employees on the List of Covered Employees employed by First Tier Subcontractor has a disqualifying criminal history under this Section 3.15; and (v) if applicable, attached to the First Tier Subcontractor Certification is a duly completed and executed Sub-subcontractor Certification in the form provided by Owner obtained by First Tier Subcontractor from each subcontractor employed on the Project by or under First Tier Subcontractor (each a "Sub-subcontractor") and employing one or more covered employees. As used herein "Sub-subcontractor Certification" shall mean a duly completed and executed certification in a form provided by Owner from each Sub-subcontractor that contains the certifications required in a First Tier Subcontractor Certification.

- G. Owner has notified Contractor that Owner has contracted with a provider of workforce screening services (the "Provider") to perform certain criminal history record information reviews and drug tests and to issue identification badges for all covered employees employed in connection with the Work. Upon Provider's receipt of a copy of the List of Covered Employees from Owner and a completed consent and authorization form as required by Provider for each covered employee requiring an initial or renewal AISD badge (defined below), Provider will perform for each such covered employee a name-based criminal history record information review (using criminal records and sex offender databases) ("Name-based Search"), and the covered employee must submit to a urine based drug test specified by Provider ("Drug Test"), scheduled through Provider. Contractor shall be responsible for paying or causing each subcontractor to pay, as applicable, to Provider all costs associated with the Name-based Searches, Drug Tests and issuance of AISD badges for the respective employees of each such employer.
- H. Each covered employee employed on the Project by Contractor or a subcontractor must wear a valid and unexpired Austin Independent School District identification badge issued by Provider (each an "AISD badge") at all times while on the Project site. Provider will not issue an AISD badge for a covered employee and will revoke a previously issued AISD badge if such employee has a disqualifying criminal history under this Section 3.15 or has failed the Drug Test (based on Department of Transportation Guidelines). After the issuance of an AISD badge and until the AISD badge expires, Provider will repeat the Name-based Search on each active covered employee on the List of Covered Employees on a monthly basis. In addition, any covered employee involved in a safety incident on the Project site will be required to immediately submit to a new Drug Test. If Provider determines at any time that an employee on the List of Covered Employees has a disqualifying criminal history under this Section 3.15 or has failed a Drug Test (based on Department of Transportation guidelines), Provider will notify Contractor and the subcontractor employing such employee that an AISD badge will not be issued for such employee or is revoked (if previously issued) effective immediately, whereupon such employee shall be marked as "inactive" on the List of Covered Employees and, if applicable, the previously issued AISD badge shall be immediately returned to Provider. If Provider does not issue an AISD badge for a covered employee or the AISD badge is revoked or has expired, the covered employee is prohibited from entering the Project site. Owner and/or its safety consultants may conduct periodic random checks of workers on the Project site to determine compliance with the badging requirements of this subsection.
- I. Contractor and each subcontractor shall, as the Work progresses, comply with the provisions of this Section 3.15 with respect to each new covered employee to be employed on the Project and not previously listed on the List of Covered Employees. Each new covered employee shall be added to the List of Covered Employees, with the name highlighted and the dated of such addition noted. In addition, as the Work progresses, each covered employee on the List of Covered Employees who is no longer employed on the Project shall be marked as "inactive"

and the last date of such employee's employment on the Project shall be noted, and for each covered employee previously designated as "inactive" and once again employed on the Project, the "inactive" designation shall be removed and the date of reemployment shall be noted. Each time Contractor makes a change to the List of Covered Employees, Contractor must submit to Owner, or its designee if directed by Owner, within five (5) business days of the date of such change, (i) an electronic copy in PDF format of the updated List of Covered Employees current as of the third (3rd) business day prior to the date of delivery, and (ii) a fully executed electronic copy in PDF format of the Contractor Certification dated within three (3) business days of the date of delivery.

- J. If, at any time as the Work progresses, Contractor, a subcontractor or Owner receives updated criminal history record information for a covered employee that includes a disqualifying criminal history under this Section 3.15, or it is determined that a covered employee is on the Project site in violation of this Section 3.15, then, notwithstanding anything contained in Section 13.3.A hereof to the contrary, Contractor shall immediately remove such employee from the Project site with no requirement of written notice from Owner, notify Provider in writing that such employee is prohibited from future entry on the Project site unless notice of same has been received from Provider, return the AISD badge to Provider, and mark such employee as "inactive" on the List of Covered Employees. All Work on the Project performed by the Contractor or any subcontractors shall stop (with no extension of the Contract Time or adjustment in the Contract Amount) until such worker is no longer on the Project site. Owner reserves the right to cause Owner's police or other security personnel to remove such worker from the Project site.

### 3.16 CRIMINAL HISTORY RECORD INFORMATION REVIEW AND IDENTIFICATION BADGES FOR NON-COVERED EMPLOYEES

Contractor shall, at its sole cost and expense, comply and cause each subcontractor to comply with the provisions of this Section 3.16 regarding criminal history record information review and issuance of identification badges for all non-covered employees (hereafter defined) in connection with the Work. Contractor's failure to comply with any of the terms and conditions of this Section 3.16 as to all non-covered employees shall be a material default under the Contract.

- A. As used herein, the term "non-covered employee" shall mean in connection with the Work an individual employed or offered employment by Contractor or a subcontractor or an individual subcontractor who is not a covered employee under Section 3.15 above. If workers employed on the Project in connection with the Work are non-covered employees, Contractor shall comply with the provisions of this Section 3.16 for such non-covered employees, and, if applicable, Contractor certifies and shall cause each subcontractor to certify that it shall maintain or cause to be maintained the conditions imposed and/or precautions taken on the Project site to ensure that such workers will not become covered employees and failure to do so shall be a material default under the Contract. If the Work involves

construction, alteration, or repair of a new facility, Contractor shall comply with this Section 3.16 for so long as the individual is not a covered employee under the provisions of TEC §22.08341.

- B. Contractor shall, at its sole cost and expense, cause to be conducted a criminal history record information review in accordance with Subsection 3.16.E below for each non-covered employee employed in connection with the Work.
- C. Contractor shall not assign to, permit or allow on the Project site any non-covered employee who has a disqualifying criminal history. A non-covered employee has a “disqualifying criminal history” under this Section 3.16 if the non-covered employee has been convicted of one of the following offenses or crimes during the preceding 30 years and the victim was under 18 years of age or was enrolled in a public school: (i) a felony offense under Title 5 of the Texas Penal Code; (ii) an offense on conviction of which a defendant is required to register as a sex offender under Chapter 62 of the Texas Code of Criminal Procedure; (iii) an offense or crime (whether a felony or a misdemeanor) involving moral turpitude, including without limitation theft, bribery, fraud, perjury, sexual offenses, or offenses involving intentional acts of violence toward persons or property; or (iv) an offense under the laws of another state or federal law that is equivalent to an offense under (i), (ii) or (iii) above. Provided, however, Contractor or a subcontractor may assign to, permit or allow a non-covered employee on the Project if the only convictions reported are crimes involving only misdemeanor theft offenses (other than theft of school district funds or property) occurring more than seven (7) years prior to the date the worker would commence work on the Project.
- D. Contractor shall maintain at all times a list of all non-covered employees on the Project (as updated from time to time by Contractor, the “List of Non-covered Employees”) which contains the following information for each non-covered employee: (i) full name; (ii) the full name of the non-covered employee’s employer, if applicable; and (iii) Texas driver’s license or other identification number. The non-covered employees on the List of Non-covered Employees shall be grouped by employer. Prior to commencement of the Work, Contractor shall deliver to Owner, or its designee if directed by Owner, an electronic copy in PDF format of the initial List of Non-covered Employees for all non-covered employees on the Project.
- E. Owner has notified Contractor that Owner has contracted with Provider (as defined in Subsection 3.15.G above) to perform certain criminal history record information reviews and drug tests and to issue identification badges for all non-covered employees employed in connection with the Work. Upon Provider’s receipt of a copy of the List of Non-covered Employees from Owner and a completed consent and authorization form as required by Provider for each non-covered employee requiring an initial or renewal AISD badge, Provider will perform for each such non-covered employee a name-based criminal history record information review (using criminal records and sex offender databases) (“Non-covered Employee Name-based Search”), and the non-covered employee must submit to a Drug Test

(as defined in Subsection 3.15.G above), scheduled through Provider. Contractor shall be responsible for paying or causing each subcontractor to pay, as applicable, to Provider all costs associated with the Non-covered Employee Name-based Searches, Drug Tests and issuance of AISD badges for the respective employees of each such employer.

- F. Each non-covered employee employed on the Project by Contractor or a subcontractor must wear a valid and unexpired AISD badge (as defined in Section 3.15.H above) issued by Provider at all times while on the Project site. Provider will not issue an AISD badge for a non-covered employee and will revoke a previously issued AISD badge if such employee has a disqualifying criminal history under this Section 3.16 or has failed the Drug Test (based on Department of Transportation Guidelines). After the issuance of an AISD badge and until the AISD badge expires, Provider will repeat the Name-based Search on each active non-covered employee on the List of Non-covered Employees on a monthly basis. In addition, any non-covered employee involved in a safety incident on the Project site will be required to immediately submit to a new Drug Test. If Provider determines at any time that an employee on the List of Non-covered Employees has a disqualifying criminal history under this Section 3.16 or has failed a Drug Test (based on Department of Transportation Guidelines), Provider will notify Contractor and the subcontractor employing such employee that an AISD badge will not be issued for such employee or is revoked (if previously issued) effective immediately, whereupon such employee shall be marked as “inactive” on the List of Non-covered Employees and, if applicable, the previously issued identification badge shall be immediately returned to Provider. If Provider does not issue an AISD badge for a non-covered employee or the AISD badge is revoked or has expired, the non-covered employee is prohibited from entering the Project site. Owner and/or its safety consultants may conduct periodic random checks of workers on the Project site to determine compliance with the badging requirements of this subsection.
- G. Contractor and each subcontractor shall, as the Work progresses, comply with the provisions of this Section 3.16 with respect to each new non-covered employee to be employed on the Project and not previously listed on the List of Non-covered Employees. Each new non-covered employee shall be added to the List of Non-covered Employees, with the name highlighted and the dated of such addition noted. In addition, as the Work progress, each non-covered employee on the List of Non-covered Employees who is no longer employed on the Project shall be marked as “inactive” and the last date of such employee’s employment on the Project shall be noted, and for each non-covered employee previously designated as “inactive” and once again employed on the Project, the “inactive” designation shall be removed and the date of reemployment shall be noted. Each time Contractor makes a change to the List of Non-covered Employees, Contractor must submit to Owner, or its designee if directed by Owner, within five (5) business days of the date of such change, (i) an electronic copy in PDF format of the updated List

of Non-covered Employees current as of the third (3rd) business day prior to the date of delivery.

- H. If, at any time as the Work progresses, it is determined that a non-covered employee is on the Project site in violation of this Section 3.16, then notwithstanding anything contained in Section 13.3.A hereof to the contrary, Contractor shall immediately remove such employee from the Project site with no requirement of written notice from Owner, notify Provider in writing that such employee is prohibited from future entry on the Project site unless notice of such violation has been received from Provider, return the AISD badge to Provider, and mark such employee as “inactive” on the List of Non-covered Employees. All Work on the Project performed by the Contractor or any subcontractors shall stop (with no extension of the Contract Time or adjustment in the Contract Amount) until such worker is no longer on the Project site. Owner reserves the right to cause Owner’s police or other security personnel to remove such worker from the Project site.
- I. Notwithstanding any provision of this Section 3.16 to the contrary, if at any time during the Project, Owner determines (in its sole discretion) that some or all of the workers have or will become covered employees, Owner shall so notify Contractor and thereafter Contractor and all affected subcontractors, with regard to their respective covered employees, shall comply with the provisions of TEC §22.08341 and Section 3.15 above. In addition, if at any time during the Project, Contractor becomes aware that some or all of the workers employed in connection with the Work have or will become covered employees, Contractor shall immediately notify Owner in writing with specificity as to the conditions on the Project site resulting in such workers becoming covered employees and thereafter Contractor and all affected subcontractors, with regard to their respective covered employees, shall comply with the provisions of TEC §22.08341 and Section 3.15 above.

#### **4. Article 4. SUBCONTRACTORS.**

##### **4.1 AWARD OF SUBCONTRACTS FOR PORTIONS OF THE WORK**

- A. Contractor has submitted or will submit, as applicable, to Owner the Contractor’s list of proposed subcontractors and material suppliers, identifying their respective subcontract amounts, in connection with the Work on the HUB\* Utilization Report (HUR)/ HUB Compliance Plan (HCP) form supplied by Owner or such other form required by Owner (“ Statement”). Contractor shall not contract with any subcontractor or supplier in connection with the Work until the Architect/Engineer and the Owner have approved the selection in writing. If the Statement has been submitted to Owner prior to Owner’s execution of the Agreement, then, unless Owner notifies Contractor in writing at the time of Owner’s execution of the Agreement that Owner does not approve a subcontractor or supplier listed on the Statement, Owner and the Architect/Engineer shall be deemed to have approved each subcontractor and supplier on the Statement and Contractor shall be obligated to contract with such subcontractors and suppliers in connection with the Work. If,

in good faith, Contractor determines at any time during the Project that the replacement of an approved or deemed approved subcontractor or supplier is necessary, Contractor must obtain Owner's and Architect/Engineer's prior written approval of such replacement. Contractor shall submit a written request for such approval to Owner and Architect/Engineer, which shall include a detailed explanation of the reason(s) for Contractor's proposed replacement, along with an amended Statement reflecting the proposed replacement. Contractor shall submit an amended Statement to reflect each approved change in subcontractors, suppliers, and/or value of subcontractor/supplier contracts resulting from change orders or other Project circumstances. Notwithstanding any provision of this Section 4.1.A to the contrary, Owner's and Architect/Engineer's approval or deemed approval of Contractor's subcontractors and suppliers during the Project shall not be deemed verification by Owner or Architect/Engineer that an approved subcontractor or supplier meets the minimum qualifications of the Project as set forth in Owner's Project Manual and Specifications. Contractor shall have an ongoing obligation during the Project to ensure that its subcontractors and suppliers on the Project meet all such applicable minimum qualifications. Contractor's failure to comply with the provisions of this Section 4.1.A shall be a material default under the Contract. In the event of any conflict between this Section 4.1 and the provisions in the Agreement regarding subcontractor selection, the Agreement shall control.

- B. If requested by a subcontractor or material supplier who submitted a bid or proposal to Contractor during the Solicitation Process but is not listed by Contractor as a proposed subcontractor or supplier on Statement, Contractor agrees to provide feedback to such subcontractor or supplier as to how its bid/proposal compared with the other bids/proposals received by Contractor for the same services or materials (e.g., bid was highest bid received, bid fell in the middle of bids received, etc.).

#### 4.2 SUBCONTRACTUAL RELATIONS

- A. All subcontracts shall be in writing.
- B. Nothing contained in the Contract Documents shall create any contractual relation between Owner and any subcontractor or supplier or any party with whom Owner or any of its subcontractors or suppliers contracts.
- C. By appropriate written agreement, 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 the Contract Documents, assumes toward the Owner and Architect/Engineer.

D. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect/Engineer under the Contract Documents with respect to the Work to be performed by the subcontractor, including Owner's rights to terminate for convenience, so that subcontracting thereof will not prejudice such rights. Where appropriate, the Contractor shall require each subcontractor to enter into similar agreements with 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 which may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such Contract Documents available to their respective proposed subcontractors.

E. Each such subcontract shall:

1. require that such Work be performed in accordance with the terms and requirements of the Contract Documents;
2. require the subcontractor to carry and maintain insurance in accordance with the Contract Documents;
3. require the subcontractor to furnish such reasonable certificates and waivers as the Owner may request;
4. require that any subcontractor waive any rights it may have against the Owner for damage caused by fire or other perils covered by property or risk insurance maintained by the Contractor or subcontractor or required to be maintained by the Contractor's subcontractor in connection with the Project.
5. provide that all warranties provided to Contractor, including material warranties, are fully assignable to the Owner;
6. provide for contingent assignability of the subcontract as herein provided;
7. require each subcontractor provide a certificate in writing to Owner that it provides workers compensation insurance coverage for each employee as required by law;



8. require subcontractor compliance with the prevailing wage rate requirements established by law and the Contract Documents; and
9. provide that the subcontract is subject to Owner's right to terminate or suspend work on the terms set forth herein.

All provisions required by the Contract to be set out in subcontracts shall be deemed incorporated by reference into each subcontract entered into pursuant to or in connection with the terms of this Contract, as if set out in full. Contractor shall be liable to Owner for any damages resulting from Contractor's failure to comply with the provisions of this Section 4.2.

#### 4.3 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

- A. Each subcontract agreement for a portion of the Work is hereby assigned by the Contractor to the Owner and the Surety; provided, however, that such assignment shall be effective as to Owner only after Owner's written termination of the Contract or of Contractor's right to proceed under terms of the Contract, and acceptance in writing by Owner of the particular subcontract.

### 5. **Article 5. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

#### 5.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

- A. 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, and the Contractor shall cooperate fully with such other contractors and Owner's employees and carefully fit Contractor's own Work to such work as directed by the Owner or Architect/Engineer.
- B. If the Contractor believes that it has suffered or will suffer delay or additional costs or damages as a result of the work performed by Owner or a separate contractor, the Contractor shall notify Architect/Engineer and the Owner in writing as soon as possible, but in no event more than 5 days after Contractor becomes aware of such conditions, in order to give Owner an opportunity to avoid, reduce or mitigate such events. Any claim by Contractor for a time extension or additional costs shall be submitted as a request for Change Order.
- C. 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.

- D. 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 schedule deemed necessary after a joint review and mutual agreement. Contractor's construction schedule shall reflect such approved construction schedules, as amended from time to time. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised and approved by the Contractor, separate contractors and the Owner.
- E. Time is of the essence of this Contract.

## 5.2 MUTUAL RESPONSIBILITY OF CONTRACTORS

- A. The Contractor shall indemnify Owner and its officers, trustees, employees and agents from all liability, loss or expense (including attorneys' fees) arising from alleged interference with or damage to the work or property of other contractors or Owner by Contractor, its subcontractors, or anyone performing Work under this Contract. This indemnification shall survive termination or completion of the Contract as to events occurring prior to such termination and completion, and shall be in addition to any other indemnification obligations set out in this Contract.
- B. 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 Owner's and/or Contractor's construction and operations with theirs as required by the Contract Documents.
- C. 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, prior to proceeding with that portion of the Work, shall look for and promptly report to the Architect/Engineer and Owner any discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Contractor shall notify them no later than five (5) days after it becomes aware of the problem or potential problem. Failure of the Contractor so to report in a timely manner 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.
- D. 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, to the extent not caused by the fault of the separate contractor. The Owner shall be liable to the Contractor for costs incurred by the Contractor

because of delays or defective construction of a separate contractor of Owner, to the extent not resulting from the fault or breach by Contractor or Contractor's subcontractors or suppliers. Each party shall promptly notify the other as soon as it becomes aware of a delay, improperly timed activity or condition of defective construction which could result in damages to the other but in no event later than five (5) days after first becoming aware of the problem. Contractor's claim shall be submitted as a request for a Change Order as provided herein.

- E. The Contractor shall promptly remedy damage caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in the Contract Documents.
- F. The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in the Contract Documents. If such separate contractor initiates legal or any other proceedings against the Owner on account of any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at its own expense, and hold harmless and indemnify the Owner, its officers, trustees, agents and employees from any and all Claims, causes of action, damages, loss, liability and expenses arising from Contractor's acts or omissions or the acts or omissions of Contractor's employees, subcontractors or parties for whom Contractor has liability. The Contractor shall pay or reimburse the Owner for all attorneys' fees and court or other costs which the Owner has incurred over and above those paid for directly by the Contractor. These obligations are in addition to all other defense and indemnification obligations under the Contract Documents, and shall survive termination or completion of the Contract.

## **6. Article 6. CHANGES IN THE WORK.**

### **6.1 CHANGE ORDERS**

- A. Owner and Contractor may at any time, without notice to or approval of the Surety, by written Change Order hereto, make changes in the Work, the Contract Amount, the Contract Time, or otherwise modify the Contract.
- B. Except for a Unilateral Change Order pursuant to Section 6.3.D. below, a Change Order is a written modification of the Contract between the Owner and Contractor, signed by the Owner, the Contractor, and the Architect/Engineer, which authorizes a change in the Scope of the Work or an adjustment in the Contract Amount or the Contract Time. Work performed under a Change Order is subject to all provisions of the Contract Documents. A Change Order will not be deemed fully executed until signed by Owner's Contracting Officer.
- C. All changes in the scope of the Work, the Contract Amount and the Contract Time shall be documented by a Change Order. Only the Contracting Officer has

authority to sign and agree to a Change Order on behalf of Owner. Neither the Architect/Engineer nor the Owner's Project Manager has the authority to bind the Owner to the terms of a Change Order without the signature of the Contracting Officer.

## 6.2 THE CHANGE ORDER REQUEST PROCESS

- A. If Owner initiates a change in the Work, Owner will request Architect/Engineer to promptly prepare a Change Order Request and deliver it to Contractor. The Change Order Request prepared by Architect/Engineer will include a description of the requested change and any related Drawings and Specifications developed and signed by the Architect/Engineer.
- B. Upon receipt of the Change Order Request, the Contractor shall determine whether the requested change will affect the Contract Amount or the Contract Time, and shall prepare and deliver to Architect/Engineer a time extension request, if applicable, and proposed pricing for the Change Order Request, with sufficient back-up, for self-performed work and work of subcontractors, as soon as possible, but in no event later than 15 days after the receipt by Contractor of the Change Order Request.
- C. Architect/Engineer will promptly review and evaluate with Owner the Contractor's proposed change to the Contract Time or Contract Amount, or both, as applicable.
- D. If Contractor's proposal is acceptable to Owner, or if Owner otherwise negotiates acceptable terms with the Contractor, Owner will prepare a Change Order which will be signed by Architect/Engineer and delivered to Contractor for signature. Contractor shall execute and return the Change Order showing the agreed-upon terms within 10 days after Contractor's receipt of it.
- E. Upon receipt of the Change Order signed by Owner, Contractor will promptly commence the requested work.
- F. If the Owner and Contractor do not agree on the terms of the Change Order, Owner may issue a Unilateral Change Order as provided in Section 6.3.D or may decide not to pursue a change to the Work at that time.

## 6.3 AGREED AND UNILATERAL CHANGE ORDERS

- A. A Change Order may be either an Agreed Change Order or a Unilateral Change Order.
- B. An Agreed Change Order is a Change Order jointly executed by the Owner and the Contractor, in which each agrees to all of the terms of the amendment.

- C. The execution of an Agreed Change Order by the Owner and the Contractor constitutes the full, final and complete settlement of all claims with regard to the modifications contained in the Change Order for impacts on the Contract Amount and/or the Contract Time; provided, however, that an Agreed Change Order may be reformed by a written modification signed by the Contractor and the Owner, for the limited purpose of correcting an error in computation. A Change Order is effective upon receipt by the Contractor, and entitles the Contractor to submit the adjusted cost of the Work on succeeding Pay Applications as it is completed.
  
- D. A Unilateral Change Order is a Change Order issued by the Owner without the agreement of the Contractor. The issuance of a Unilateral Change Order does not prejudice any of the Contractor's rights to relief otherwise available under the Contract Documents. The Contractor may preserve such rights by submitting a written objection to the Unilateral Change Order within 30 days after receipt of the Unilateral Change Order. If the Contractor does not submit a written objection within that time, Contractor shall be deemed to have accepted the terms of the Unilateral Change Order and the Unilateral Change Order shall have the full force and effect of an Agreed Change Order.

#### 6.4 INTERIM CHANGE AUTHORIZATION

- A. When the Owner determines that changes in the Work must be made promptly in order to prevent damage to the Work in place, to prevent significant delay in the Project or to maintain safety, the Owner may issue an Interim Change Authorization directing the Contractor to proceed with changes in the Work prior to completion of the Change Order process. The Interim Change Authorization shall provide for the work to be performed on the basis of cost and/or time not to exceed specified amounts.
  
- B. Upon receipt of the Interim Change Authorization, Contractor shall commence the Work and keep records on the time and cost incurred in the performance of the Work. Contractor shall be entitled to payment for work performed under an Interim Change Authorization in an amount not to exceed 50% of the "Additional cost not to exceed" amount stated in the Interim Change Authorization. Contractor shall not be entitled to receive the balance of payment for such work until the Change Order is fully executed.

#### 6.5 CHANGE ORDER REQUESTED BY CONTRACTOR

- A. A request for a Change Order may be initiated by the Contractor as provided in Section 6.5.B or C.
  
- B. If the Contractor believes that it will incur additional cost or time because of any written interpretation of the Contract Documents, or any written or oral instruction concerning the execution of the Work issued by the Owner or the Architect/Engineer, and constituting a change in the scope or character of the Work, the Contractor must promptly notify the

Owner and Architect/Engineer of the Contractor's belief before beginning the requested work. Contractor shall provide Owner and Architect/Engineer with written notice that there will be a time extension and/or additional cost for the requested Work as soon as possible but in no event later than 5 days after Contractor receives the instructions from Owner or Architect/Engineer. In addition, Contractor must provide Owner and Architect/Engineer with a written proposal for the time and/or cost of the requested work, and a justification for such additional time or expense, within 15 days after Contractor receives the request for the change in Work.

1. If the Owner determines that the change in the Work should take place, the Owner will initiate the Change Order process, which will conclude in either an Agreed or Unilateral Change Order as provided herein.
  2. Except for a change in the Work due to an Emergency Condition, as provided in Section 9.9, the Contractor may not commence the requested change in the Work without a signed Change Order or Interim Change Authorization. Contractor shall not be entitled to an increase in the Contract Amount or an extension of the Contract Time if it performs a change in the Work without a signed Interim Change Authorization or Change Order, except as provided in Section 9.9 for an Emergency Condition.
  3. Except as herein provided, no order, statement or conduct of an Owner or the Architect/Engineer shall entitle the Contractor to an increase in the Contract Time or Contract Amount for work performed.
- C. The Contractor may request a Change Order for damages under the following circumstances only, provided that all notification and other requirements for Contractor's establishment of those rights as provided in the Contract Documents have been met:
1. Unanticipated physical conditions at the site, pursuant to Section 3.3 which the Architect/Engineer addresses by means of changes in the Drawings and Specifications, or unanticipated environmental conditions at the site as described in Section 9.7;
  2. The existence of errors, omissions and imperfections in the design documents which the Contractor could not reasonably have detected or brought to the attention of the Owner and Architect/Engineer in time to correct without a delay in the construction, as provided in Section 3.2;
  3. Unexcused Owner delays, including failure of the Owner or the Architect/Engineer to take timely actions required under the Contract Documents or to provide information required by the Contractor to proceed

with the Work within the time period provided by the Contract, or if no time period is specified, within a reasonable period of time; and subject to the provisions of Section 7.1.C;

4. Delays caused by Owner's separate contractor in performing work on the Project as provided in the Contract in Section 5.1 and Section 7.1.C;
5. Additional cost or delays caused by emergency conditions, not due to the fault of Contractor or anyone for whom Contractor is liable, as provided in Section 9.9; or
6. Any other provision of the Contract that expressly permits Contractor to obtain an adjustment to the Contract Time and/or Contract Amount, in accordance with such provisions.

Contractor's request for a Change Order must be in writing, must describe the events authorizing the adjustment in the Contract Time and/or Contract Amount, and must provide a justification for the amounts requested. Contractor's request for a Change Order must be submitted to Owner within the time period provided by the Contract, or if no time period is provided, then no later than 15 days after the commencement of the event which gives rise to a claim for a Change Order. Contractor's failure to observe the notice requirements set forth in the Contract Documents which are intended to provide Owner with notice of a problem, potential problem or delay and an opportunity to investigate and take action to eliminate or ameliorate the problem, may constitute a failure to mitigate damages affecting the Contractor's right to an adjustment of the Contract Time and/or Contract Amount.

- D. The Contractor may request a time extension for excused delays as provided in Article 7. In order to request an extension of the Contract Time, Contractor must comply with the requirements of Article 7 and submit a Time Extension Request with its payment request, as provided therein.
- E. In evaluating a request for an adjustment of Contract Time in response to Contractor's request for a Change Order, in no event will an extension of time be granted for delays that merely extend the duration of non-critical activities, or which consume only float without delaying the Substantial or Final Completion date. Any extension of the Contract Time granted shall be net of any unexcused delays caused by or due to the fault of Contractor or anyone performing Work under the Contract. No delay days shall be given for time periods in which the delay complained of ran concurrently with excused delays or with other conditions which prevented performance. If more than one cause of delay is asserted for any given time period, only one extension of time will be permitted for such period.

- F. Except as expressly provided in this Section 6.5, and subject to the provisions of the Contract Documents, Contractor shall not be entitled to an increase in the Contract Sum or the Contract Time and shall bear full responsibility for all risks affecting the Contractor's cost of performance. Contractor's right and entitlement to adjustments in Contract Time or the Contract Amount are subject to applicable provisions in the Contract Documents establishing Contractor's rights or the waiver of those rights, including, without limitation, those set forth in Article 7. Nothing in this Section 6.5 is intended to enlarge the Contractor's rights, or to provide the Contractor with additional rights not otherwise granted under the terms of the Contract Documents.

## 6.6 BASIS FOR COMPENSATION FOR CHANGES

- A. Method of Compensation. The cost for extra work performed by Contractor or subcontractor will be determined by either (1) an agreed lump sum, (2) an agreed unit price or (3) an actual field cost, as agreed to by Owner. The allowable mark-up percentages for extra work are described in Section 6.6.E below. Extra work will be subject to the following limitations and proposals will be submitted accordingly.
- B. Lump Sum. If the lump sum method is used, the Contractor shall submit appropriate supporting data as described herein. For general construction Work, the Contractor shall submit a breakdown consistent with Contractor's pay estimate breakdown, detailed with estimated quantities for both labor and materials. Unless otherwise provided in the Contract Documents, costs for the purposes of Article 6 shall be limited to the following, and the amounts charged shall only be those costs incurred as a direct result of the change in the Work:
1. costs of direct labor, including social security, old age and unemployment insurance, and workers' compensation insurance paid by Contractor. (Labor, as used in this subsection, shall mean labor or services performed by the Contractor's Superintendent and employees under the Superintendent, and all subcontractors and suppliers.);
  2. costs of materials, supplies and equipment, exclusive of all hand tools and such other machinery and equipment of the trade customarily owned by construction workers, including cost of transportation, whether incorporated or consumed;
  3. rental costs of machinery and equipment, exclusive of all hand tools and such other machinery and equipment of the trade customarily owned by construction workers, whether rented from the Contractor or others;
  4. costs of premiums for all bonds and insurance required by Owner to be provided and permit fees related to the Work; and



5. field office expense where the Contractor's field office must be maintained primarily on account of the change in the Work.
- C. Unit Price: If the unit price method is used, the Contractor shall submit a proposal based on unit prices stated in the Bid Proposal or Contract Documents, or agreed upon by the Contractor and Owner subsequent to Contract Bids.
- D. Actual Field Cost: If actual field costs are used, the Contractor shall keep and submit, in such form as the Architect/Engineer and Owner may prescribe, an itemized accounting together with appropriate supporting data, of actual costs incurred as described in Article 6 above.
- E. Allowable Mark-ups.
1. Unless otherwise expressly provided by the Agreement, the Contractor and subcontractor will be allowed mark-up percentages for overhead and profit for changes in the Work as described below. If the Agreement specifies allowed mark-up percentages for the Contractor, but not for the subcontractors, then the mark-up percentages provided in Section 6.6.E.2 below shall only apply to subcontractors, and the provisions of the Agreement shall control the mark-ups allowed to Contractor. All other provisions of this Section E regarding mark-ups, other than the allowed percentages, will apply to both Contractors and subcontractors, unless the Agreement expressly provides other terms and conditions. The percentage mark-up allowed the Contractor and subcontractor shall cover and compensate Contractor for Contractor's profit and overhead, which include home and field office expense, home and field office personnel, and all other expenses not embraced in the Method of Compensation defined in Article 6. No separate allowance for overhead shall be allowed. Where the Contractor's field office must be maintained primarily on account of the change in the Work, the cost to operate and maintain the same shall be included in the Method of Compensation before calculation of allowable markup. On changes involving deleted items, the Owner shall receive credit for overhead and profit on each deleted item.
  2. For Work performed by Contractor's own employees, the maximum allowable mark-up percentage of the actual cost of the Work will be 20% on the first \$10,000, 15% on the next \$10,000 and 10% on the balance over \$20,000; however, the minimum total mark-up shall be not less than \$75. If subcontracted Work is involved, the Contractor will include with Contractor's cost proposal a detailed breakdown for the subcontractor in accordance with the above requirements for the Contractor. For Work performed by a subcontractor's own employees, the subcontractor will be allowed the same mark-up percentages as provided above for the Contractor. The Contractor will be allowed the following mark-up on subcontracted Work being performed by forces other than Contractor's own employees: a maximum of 10% on the first \$30,000, 7 1/2% on the next \$30,000 and 5% on the balance over \$60,000; however, the minimum total

mark-up shall be not less than \$75. For subcontracted Work being performed by forces other than the subcontractor's own employees (e.g, subcontracted Work being performed by the employees of a subcontractor to the Contractor's subcontractor), such subcontractor whose employees are not performing the subcontracted Work will be allowed the same mark-up percentages as provided in the immediately preceding sentence for Contractor.

3. If the scope of Work is reduced by the Owner such that the Contractor will not incur costs for deleted Work, the Contractor will credit those costs to the Owner and retain only Contractor's overhead and profit incurred prior to notification of Owner's reduction of the scope of the Work. If extra Work is requested by the Owner, the Contractor will be allowed to add to Contractor's actual costs a percentage as noted above to cover Contractor's overhead and profit. When both additions and credits covering related Work or substitutions are involved in any one change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.
4. Contractor shall submit for payment of the Change Order Work as part of Contractor's regular submission of an Estimate for Partial Payment.

## **7. Article 7. TIME DELAY**

### **7.1 CONTRACTOR EXCUSED DELAYS**

The Contractor's right to proceed or perform the Work shall not be terminated for default, nor the Contractor charged with liquidated damages or other remedies for delay under the Contract Documents, due solely to delays that are excused under the provisions of this Section 7.1. In order to have a delay considered an excused delay under this Article 7, Contractor must provide all notices regarding the delay required by this Article 7 and by any other provisions of the Contract Documents in a timely manner, including the submission of Time Extension Request forms with its Estimate for Partial Payment as required under the terms of the Contract Documents. Any provision of the Contract Documents to the contrary notwithstanding, if Contractor fails to achieve Substantial Completion by the Substantial Completion Date set by the Contract, delays in the completion of the Work occurring after the Substantial Completion Date shall in no event be considered excused delays under this Article 7 and Contractor shall not be entitled to extensions of the Contract Time for any such delays.

#### **A. Contractor Force Majeure.**

1. A delay in the completion of the Work that arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor or any subcontractor, and which could not have been prevented through the exercise of reasonable care, including but not restricted to, acts of God, acts

of the public enemy, acts of terrorism, acts of federal, state or local government in its sovereign capacity, fires, floods, epidemics, quarantines, restrictions, strikes, freight embargoes, unusually severe weather (excluding delays caused by above-average but not excessive rainfall) as described in B below, or delays of Owner as described in Section C below, shall be considered an excused delay provided that all notices are given as required by the Contract Documents. The failure of the Contractor or any subcontractor to order supplies, materials or equipment when shortages are known or expected, in time to perform the Work in accordance with the Contract Documents, is not an excused delay.

2. Within 5 days ~~from the date~~ that Contractor first becomes aware of a delay or the likelihood of delay from a force majeure event, Contractor must notify Owner, the Contracting Officer and Architect/Engineer in writing of the cause of delay and, if possible, Contractor's estimate of duration, to enable Owner to investigate and document the cause and duration of the delay. The Contractor shall submit with each Estimate for Partial Payment a "Time Extension Request" form (provided by the Owner) documenting any requests for Contract time extension. If Contractor fails to provide the notice required by this subsection, and Owner is unable to adequately verify the cause or duration of the delay, or the impact of the force majeure event on the construction schedule, the delay will not be considered excused.

B. Delay for Weather Conditions.

1. The Contract Time set out in the Contract Documents is deemed to include normal weather conditions at the Project site. The Contractor may be entitled to an excused delay due to unusual and severe weather conditions if the weather conditions (i) are excessive and severe for the period of time, (ii) could not have been reasonably anticipated, and (iii) had an adverse effect on the scheduled construction and Contractor reasonably performed other Work on the Project in place of the scheduled work and still incurred a delay in the construction schedule. In order to be entitled to a delay on this basis, Contractor must provide Owner and Architect/Engineer with notice of the delay (as provided herein) and (ii) data substantiating the claim, including weather information issued by the National Oceanic and Atmospheric Administration ("NOAA") for the city in which the Project site is located (or if such information is not available for the Project site location, then for the closest city) which shows that the weather conditions were in excess of those that are normal for the site, and job logs that indicate impacted work and estimated effect of the weather. Unless the parties agree to a different method of determining weather conditions, weather information produced by NOAA will be used to determine normal and abnormal weather conditions at the Project site.

2. In order to be entitled to a Contract Time extension due to weather conditions, Contractor must provide Owner and Architect/Engineer with notice of the adverse condition and its impact on the construction schedule as soon as Contractor becomes aware that a delay will or is likely to occur, to enable Owner to investigate and document the conditions, but in no event later than 5 days after the date of the commencement of the weather condition giving rise to the claim for the delay. The Contractor shall submit with each Estimate for Partial Payment a "Time Extension Request" form (provided by the Owner) documenting any requests for Contract Time extension. If Contractor fails to provide the notice required by this subsection, and Owner is unable to adequately verify the cause or duration of the delay, or the impact of the weather condition on the construction schedule, the delay will not be considered excused.

C. Delay Caused by Owner.

1. If the Contractor is delayed at any time in the construction of the Work through no fault of Contractor or any subcontractor, by an act of the Owner or Architect/Engineer (other than an excused delay), or of a separate contractor employed by the Owner (other than an excused delay), then the Contractor shall promptly notify the Owner and Architect/Engineer, in writing, of such delay, to enable Owner and/or Architect/Engineer to take action to reduce or eliminate the delay. Contractor must notify Owner and Architect/Engineer in writing as soon as possible after it becomes aware of the condition that it believes has caused or will be likely to cause a delay, but in no event later than 5 days after it becomes aware of such condition. Contractor's failure to do so will constitute a failure to mitigate damages. Owner shall not be liable for damages or delays for the period before notice of the delay is given to Owner.
2. The Contractor shall submit with each Estimate for Partial Payment a "Time Extension Request" form (provided by the Owner) documenting any requests for Contract time extension. Owner's proper exercise of any of its rights or remedies under the Contract Documents, including, but not limited to, remedies of suspension of the Work or requirement for correction or re-execution of any defective Work, shall not under any circumstances be construed as constituting a delay to Contractor's performance of the Work.

## 7.2 OWNER EXCUSED DELAYS

- A. Owner shall not be deemed in default in its obligations under this Contract, nor shall Contractor be entitled to remedies, rights or damages as a result of a delay by Owner in the performance of its obligations under the Contract as a result of one or more of the following: unforeseeable causes beyond the control and without the fault or negligence of the Owner, its officers or employees, including but not restricted to, acts of God, acts of the public enemy, acts of terrorism, acts of federal,

state or local government acting in its sovereign capacity, fires, floods, epidemics, quarantines, restrictions, strikes, freight embargoes, unusually severe weather, or acts of Architect/Engineer or its consultants or their respective employees or separate Contractors, at any time arising from unforeseeable causes beyond the control and without the fault or negligence of such parties, or delays caused by Contractor or any subcontractor. A delay described in this Section 7.2.A shall constitute an event of force majeure applicable to Owner.

- B. Owner shall use reasonable efforts to notify Contractor promptly after it becomes aware of the occurrence of an event giving rise to a delay. If Owner's performance is delayed through an event constituting an excused delay, Owner shall be entitled to an equitable extension of time in which to perform its obligations.

### 7.3 CONTRACTOR REMEDIES FOR DELAY

- A. In the event of an excused delay under Section 7.1 A, B or C. Owner will provide Contractor with such reasonable extension of the Contract Time as may be equitable, provided that all conditions for obtaining an extension are met, unless Owner determines to require acceleration of the Work, as provided in Section 7.3.C. The time extension will be set out in a Change Order as provided in Article 6. Any such extension of the Contract Time shall be net of any unexcused delays caused by or due to the fault of Contractor or anyone performing Work under the Contract, (including the financial condition of the Contractor or any subcontractor).
- B. Any provision of the Contract Documents to the contrary notwithstanding, it is expressly agreed that the extension of the Contract Time (or payment for acceleration of the Work as provided in Section 7.3.C) shall be Contractor's sole remedy for any delay unless the same shall have been caused by acts of the Owner which are a direct and unavoidable cause of damage to Contractor, and then only to the extent that such acts continue after Contractor's written notice to Owner of such delay as provided in Section 7.1 C.1 and Owner is not prevented from correcting the delay due to an event of force majeure.
- C. Any provision in the Contract Documents to the contrary notwithstanding, in the event Contractor would be entitled to an extension of the Contract Time under the provisions of the Contract Documents, Owner shall have the right, instead of awarding additional time, to require Contractor to accelerate the Work, as provided in Section 13.2, and Owner shall pay Contractor for the reasonable additional costs incurred by Contractor that are attributable to such acceleration, as provided by Change Order.

### 7.4 OWNER REMEDIES FOR DELAY

- A. Liquidated Damages: Time is of the essence in this Contract, it being important that this Project be quickly and timely completed. The Contractor and Owner acknowledge the difficulty of ascertaining actual damages for delay in

performance, and therefore the Contractor and Owner understand and agree that for each and every day the Work or any portion thereof shall remain substantially incomplete after the Substantial Completion Date set by the Contract, Owner shall be entitled to liquidated damages as described in the Agreement. Liquidated damages may be withheld by Owner from amounts due to Contractor, or if not so withheld in full or in part, such amounts owing will be payable to Owner within 30 days after demand by Owner.

- B. Acceleration of the Work: In addition to any other rights and remedies available to Owner under the Contract Documents or available at law or equity, in the event the Work has been delayed due to unexcused delay by Contractor, or otherwise due to the fault of Contractor, its subcontractors, or anyone providing Work under this Contract, Owner may direct that the Work be accelerated by means of overtime, additional crews, additional shifts and/or resequencing of the Work in order to bring it back on schedule and/or to maintain it there as described in Section 13.2

## **8. Article 8. PAYMENTS AND COMPLETION**

### **8.1 PROGRESS PAYMENTS**

- A. Promptly following execution of the Contract by Owner and the Contractor, the Contractor shall submit a Schedule of Values to the Architect/Engineer for approval, consisting of a breakdown of the Contract Amount, itemizing material and labor for the various classifications of the Work and the costs allocated thereto, which shall be aligned with the subcontractor and supplier contract values reported on the Statement, prepared in such form and supported by such data to substantiate its accuracy, as the Owner may require. The breakdown will be used as a basis for reviewing the Contractor's Estimate for Partial Payment. The descriptions of Work classifications and the level of detail of Work activities reported on the Schedule of Values shall align with such terminology and level of detail in the Construction Schedule to allow review of both documents in consideration of progress payments. The Contractor's Estimate for Partial Payment must be submitted on the AISD Estimate for Partial Payment Form provided by Owner with two (2) signed original counterparts. A Time Extension Request form shall be submitted with each Estimate for Partial Payment whether or not an extension of time is requested. If an extension of time is requested, Contractor must state in the Time Extension Request the number of days requested and the cause for delay. In addition, Contractor shall submit with each Estimate for Partial Payment a HUR form confirming payment amounts to HUB firms.
- B. Upon submission by the Contractor of its Estimate for Partial Payment accompanied by written invoices, and such other documentation as Owner or Architect/Engineer may require to substantiate the payment requested and Work performed, as well as any other documentation required to be submitted under the Contract Documents, Owner shall make payments not less frequently than monthly as the Work progresses, based upon percentage of the completion of the Work as

determined from the Estimate for Partial Payment submitted by the Contractor, approved by the Architect/Engineer and approved by a Contracting Officer. The Contractor shall not submit the first Estimate for Partial Payment sooner than thirty days after commencement of the Work. No payment shall be made to the Contractor until all post-proposal or post-bid information, as applicable, has been submitted, approved and performance of Work begun. Payments will be made in accordance with the following provisions:

1. for Contract amounts of \$400,000 or more, payments will be made to the Contractor by the Owner within fifteen days from the date the Estimate for Partial Payment is approved by the Architect/Engineer and Contracting Officer (if the Estimate is undisputed and in proper order). Payment will be made in the amount of ninety-five percent (95%) of the value of all labor and materials fixed in proper position and all materials and equipment properly stored on the premises or other locations for which the Owner has expressed written approval.
  2. for Contract amounts less than \$400,000, payments will be made to the Contractor by the Owner within fifteen days from the date the Estimate for Partial Payment is approved by the Architect/Engineer and Contracting Officer (if the Estimate is undisputed and in proper order). Payment will be made in the amount of ninety percent (90%) of the value of all labor and materials fixed in proper position and all materials and equipment properly stored on the premises or other locations for which the Owner has expressly approved in writing, subject to the following provisions: (a) 10% of each Estimate shall be retained until the Work is 50% complete based on the percentage that the value of all labor and materials fixed in proper position bears to the total value of the Work under the Contract; (b) after the Work is over 50% complete, Owner may, at its sole discretion, reduce the amount of retainage to 5%, provided that the Contractor is not in default, the Contract is bonded, the Work is on current schedule and there is no controversy regarding the acceptability of the workmanship and materials or products, and provided further that the Architect/Engineer determines that the Work is in conformance with the Contract Documents. If any of these conditions do not continue, Owner may, at its sole discretion, reinstate the full 10% retainage until such time as the above conditions are met, in addition to any other rights and remedies it may have under the Contract.
- C. When the Project is Substantially Complete, the retained amount may, at the Owner's discretion, be reduced to only that amount necessary to assure full performance of the Contract.
- D. Owner shall not be bound to make Partial Payments if Performance and Payment Bonds are not required under the Contract. Owner shall have the right to make payment only on Final Completion of the Work.

- E. All amounts withheld by Owner as retainage and which are payable to the Contractor after Owner has deducted out liquidated damages and/or any other amounts to which Owner is entitled under the terms of the Contract, are payable to the Contractor with the final payment.
- F. All material and work covered by Partial Payments made shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and work upon which Payments shall have been made, or the restoration of any damaged work or as a waiver of the right of Owner to require strict fulfillment of all of the terms of the Contract. Payments to the Contractor shall not be construed to release the Contractor or its sureties from any obligation under this Contract.
- G. Upon receipt of each payment from Owner, Contractor shall, in accordance with Section 2251.022 of the Texas Government Code, make appropriate payments due to its subcontractors not later than the 10<sup>th</sup> day after the date Contractor receives each such payment from Owner, and Contractor shall require each subcontractor receiving payment from Contractor to make appropriate payments due to the subcontractor's respective subcontractors and suppliers not later than the 10<sup>th</sup> day after the date such subcontractor receives each such payment from Contractor in accordance with Section 2251.023 of the Texas Government Code. Pursuant to Section 2251.028 of the Texas Government Code, Contractor and each subcontractor shall pay interest as a payment is overdue. Interest shall be paid as set forth in Section 2251.025 of the Texas Government Code. If at any time Contractor or any subcontractor has questions concerning the process for payments by Owner under the Contract, such questions can be directed to the AISD Executive Director of Construction Management (or his/her designee) at 512-414-1715.

## 8.2 PAYMENTS WITHHELD OR NULLIFIED

- A. The Architect/Engineer or Owner may withhold or nullify any progress payment or final payment in whole or in part, to the extent necessary in the Architect/Engineer's or Owner's reasonable opinion to protect the Owner from loss for which the Contractor is responsible, including loss because of:
  - 1. defective Work not remedied;
  - 2. third party claims threatened, 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 Amount;
  5. damage to the property of Owner, a third party, or another 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;
  7. failure to carry out the Work in accordance with the Contract Documents; or
  8. failure to provide any submittals or documentation required under the Contract Documents in a timely manner, including updated versions of Contractor's Construction Schedule, current Time Extension Request, and HUR form confirming payment amounts to HUB firms.
- B. If the above reasons for withholding payment are removed, and any defaults cured in a timely manner and prior to Owner exercising other rights or remedies, and no other condition of default or reason for withholding, offsetting or nullifying payment exists, then payment will be made for amounts previously withheld. To the greatest extent permitted by applicable law, Owner shall not be deemed to be in breach of the Contract Documents by reason of the withholding of any payment which Owner is entitled to withhold pursuant to, or which it withholds in good faith in reliance on, any provision of the Contract Documents, and no interest shall accrue in connection with the withheld payment(s) determined to have been properly withheld. In determining whether amounts claimed for payment by Contractor, or any subcontractor, are in dispute, Owner shall have the right to consider amounts withheld under this provision, due to Contractor fault or in an attempt to protect the public from loss or overpayment of public funds, to be amounts in dispute. Nothing in this Section or in the Contract Documents shall limit or reduce any right of the Owner to offset amounts owed to Contractor by amounts Contractor owes to Owner, or to exercise any other rights or remedies provided by law or equity.
- C. In accordance with Section 2251.021 of the Texas Government Code, undisputed payments not paid by Owner to Contractor are overdue on the 31<sup>st</sup> day after the later of (1) the date Owner receives the goods under the Contract Documents; (2) the date the performance of the service under the Contract Documents is completed; or (3) the date the Owner receives an invoice for the goods or services. Provided, however, if the Board of Trustees of Owner meets only once a month, such undisputed payments not paid by Owner to Contractor are overdue on the 46<sup>th</sup> day

after the later event described in (1) – (3) of the preceding sentence. A payment begins to accrue interest on the date the payment becomes overdue at the rate of interest set forth in Section 2251.025 of the Texas Government Code.

### 8.3 SUBSTANTIAL COMPLETION

- A. 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/Engineer for review and approval a comprehensive list of items to be completed or corrected and a schedule for completion (“Contractor’s List”) which is acceptable to the Owner. The Contractor shall proceed promptly to complete and correct items on the Contractor’s List, including any items added to the Contractor’s List by the Architect/Engineer during the Architect/Engineer’s review or the period thereafter prior to final acceptance of the Work (the Contractor’s List and any items added by Architect/Engineer prior to final acceptance of the Work are collectively called the “punch list”). Failure to include an item on the punch list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Upon receipt of the Contractor’s List, the Architect/Engineer will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If, upon such inspection, the Architect/Engineer determines that the Work or a designated portion thereof is not substantially complete, Contractor shall be charged with the cost to Owner of any and all additional inspections deemed necessary by the Architect/Engineer or Owner to determine that the Work or a designated portion thereof is substantially complete. When the Work or designated portion thereof is determined by Owner to be substantially complete, the Architect/Engineer will prepare a Certificate of Substantial Completion which shall (i) establish the date of Substantial Completion, (ii) establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, (iii) fix the time within which the Contractor shall finish all items on the punch list accompanying the Certificate, and (iv) specify each item on such punch list for which the warranties required by the Contract Documents shall commence on the date Owner and Architect/Engineer determine that Contractor has finally completed such punch list item in full and strict conformity to the Contract Documents. If no time period for completion of the punch list is fixed in such Certificate of Substantial Completion, the Work, including all items on the punch list, must be completed within sixty (60) days after Substantial Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless as otherwise provided in Section 3.11.A hereof. 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.

- B. Upon Substantial Completion, Section 5 of the “Certification of Compliance” form [TEA §61.101(d)] must be executed by the Contractor and returned to the Architect/Engineer, who will forward same to Owner.

#### 8.4 FINAL ACCEPTANCE AND PAYMENT

- A. The Contractor shall notify the Architect/Engineer when the Work, including the punch list, is complete, and the Architect/Engineer will arrange a final inspection with the Contractor and the Owner. If, upon inspection, the Architect/Engineer or Owner determines that the Work, including the punch list, is not complete, Contractor shall be charged with the cost to Owner of any and all additional inspections deemed necessary by the Architect/Engineer or Owner to determine that the Work, including the punch list, is complete. If Contractor fails to complete the Work, including the punch list, within the time period for completion of the punch list fixed by the Architect/Engineer in the Certificate of Substantial Completion or within sixty (60) days after Substantial Completion, whichever is later, Owner may charge Contractor with the reasonable cost to Owner of additional Architect/Engineer services (including Project site visits) deemed necessary pending Contractor’s completion of the Work, unless such services relate only to new Work authorized by Change Order following the date of Substantial Completion. Upon completion of the Work, including the punch list, in full and strict conformity to the Contract Documents, final acceptance of the Work by a Contracting Officer, and Contractor’s satisfaction of its obligations for final payment, Owner shall pay the unpaid balance of the Contract Amount less any sum that may be necessary to settle any claim Owner may have against the Contractor or that may be necessary to settle any outstanding obligations of the Contractor or of its subcontractors arising out of or incidental to the performance of the Contract or which is otherwise withheld pursuant to the terms of the Contract Documents. Neither the Certificate of Substantial Completion, nor final acceptance payment, nor any other provisions in the Contract Documents, shall relieve the Contractor of its obligations under the Contract Documents or under any warranty.
- B. Prior to final payment and as a condition thereto, Contractor shall furnish Owner with all warranties, instructions, lien releases, documents and other submittals required by the Contract Documents, or otherwise required by Architect/Engineer or Owner, a notarized Certificate of Satisfaction of Bills, stating that all bills and claims for labor, materials, equipment and otherwise, connected with the Work for which the Owner or the Owner’s property might be responsible or encumbered, shall have been satisfied, or will be fully satisfied out of the final payment within 30 days of Contractor’s receipt of such payment. Contractor shall also furnish a release of all claims against Owner, in form satisfactory to Owner, whether of Contractor, subcontractors or of others, arising under and by virtue of the Contract. In addition, the Contractor shall deliver to Owner all As-Built Drawings and three Owner’s Manuals containing all Contractor and subcontractor names, addresses and phone numbers; all warranties and plumbing, electrical, and communication equipment/fixture product data; all special equipment product data; and all parts

lists and operating, maintenance, and service manuals. In the event there are any (1) subcontractors, suppliers or other third-party claims against Contractor which will not be satisfied by Contractor after final payment is made, or (2) any claims which are not currently subject to dispute resolution procedures set out in the Contract but which Contractor does not deem to have been settled, the Contractor shall notify Owner in writing no later than the time of final Application for Payment. Owner shall have the rights with regard to such claims provided for in the Contract Documents. If Contractor does not expressly notify Owner of any and all specific claims against Owner which are not already pending and subject to negotiation or other claim resolution procedure as provided by this Contract, and which Contractor deems unsettled, then Contractor waives all such claims by Contractor's acceptance of final payment.

- C. Owner shall not be obligated to make any progress payment or the final payment if the Surety objects to such payment or refuses to consent to such payment, or withdraws its consent to such payment. If requested by the Surety, or if Owner determines that it is advisable to do so, Owner shall have the right to make payments jointly to Contractor and Surety, or to Contractor and any subcontractor, supplier, or other person claiming payment for labor or materials. In the event of a dispute between Contractor and/or the Surety or persons performing labor or supplying materials, or to a third party claimant, as to whom payment of amounts held by Owner should be made, Owner shall have the right to interplead the funds held by it in the registry of a court of competent jurisdiction, and to withhold from the amounts held by Owner all attorney's fees and other costs incurred by Owner in connection with such dispute.
  
- D. The Contractor shall arrange for a reasonable amount of instruction for the Owner's employees and representatives to insure proper operation of all equipment furnished. The Contractor and, in particular, the Fire Protection, Plumbing, Heating, Ventilating and Air Conditioning, Building Automation and Automatic Temperature Control Systems, Electrical, and Electronic Security subcontractors shall not assume that the Owner's employees possess special expertise or have had any previous experience whatsoever in the operation and maintenance of sophisticated mechanical, electrical and electronic equipment. It is the intent of this Subparagraph to require the Contractor and the applicable subcontractors to furnish as much detailed instruction as is necessary to educate reasonably intelligent personnel in the proper use of equipment. The Manufacturer's representative shall provide this instruction for each item of equipment. In some cases, this may require several visits to the Project by those responsible for the instruction. Further, the Contractor shall establish an operating and maintenance training program for the Project for the Owner's employees as herein more particularly provided in the Contract Documents. Such training program shall include instruction courses with respect to all of the school facilities and building systems comprising the Project.

- E. Acceptance of final payment by the Contractor shall constitute a waiver of claims by the Contractor against Owner except those previously made in writing and identified by Contractor as unsettled at the time of final Estimate for Partial Payment. Final payment is considered to have taken place when Contractor or any of its representatives negotiates Owner's final payment check, whether labeled final or not, for cash, or deposits the check in any financial institution. The provisions of this Article shall not be altered, reduced or diminished by any notation, statement or reservation written on the check by Contractor in connection with its endorsement. Such notification, statement, or reservation shall be deemed an invalid attempt by Contractor to amend the provisions of this Contract without the Owner's written consent.

## **9. Article 9. PROTECTION OF PERSONS AND PROPERTY**

### **9.1 SAFETY PRECAUTIONS AND PROGRAMS**

- A. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar with and comply with all requirements of Public Law 91-596, 29 U.S.C. §§ 651 *et seq.*, the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to enforce and comply with all applicable provisions of OSHA. Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property to protect them from damage, injury or loss and shall erect and maintain all necessary safeguards for such safety and protection.
- B. Contractor shall notify owners of adjacent property and of underground facilities and utility owners when prosecution of the Work may affect them or their facilities, and shall cooperate with them in the protection, removal, relocation and replacement of their facilities and/or utilities.
- C. Contractor shall be responsible for coordinating the exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in connection with laws and regulations.
- D. Contractor shall be responsible for initiating and holding regular safety meetings at least once per week.
- E. On or before the 10<sup>th</sup> day of each calendar month, Contractor shall submit to Owner a monthly report in a form provided by Owner stating the total man-hours worked at the Project site by Contractor and all subcontractors each day during the immediately preceding calendar month. For purposes of completing this monthly man-hour report, Contractor's daily observation at the Project site of the number of workers and hours worked is sufficient.

- F. With respect to each injury on the Project site, Contractor shall furnish to Owner a copy of Contractor's first report of injury report within one (1) business day after Contractor's filing of such report with its insurance company, but in no event later than the sixth (6<sup>th</sup>) day after the date of such injury. In addition, Contractor shall notify the AISD/TASB Safety Department by telephone at 512-791-7662 immediately upon the occurrence of an injury at the Project site.

## 9.2 EMERGENCY FACILITIES

- A. Contractor shall maintain at all times free access to fire lanes and emergency and utility control facilities such as fire hydrants, fire alarm boxes, utility valves, manholes, junction boxes, etc.

## 9.3 SAFETY OF PERSONS AND PROPERTY

- A. The Contractor shall take all reasonable precautions for safety of, and shall provide all reasonable protection to prevent damage, injury, or loss to:
  - 1. Students, faculty, employees and visitors at any school where construction or renovation activities are being conducted and neighboring property owners;
  - 2. Persons performing Work on the Project site and other persons who may be affected thereby;
  - 3. The Work and all materials and equipment to be incorporated therein, whether in storage or off site, under care, custody or control of Contractor or any of its subcontractors; and
  - 4. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, fences, roadways, structures and utilities not designed for removal, relocation or replacement in the course of construction.
- B. The Contractor shall comply with all applicable laws, ordinances, rules, regulations, policies of the Owner's Board of Trustees and lawful orders of any public authority having jurisdiction for safety of persons or property or to protect them from damage, injury or loss.
- C. For all excavation of trenches (as that term is defined in the regulations under the United States Occupational Safety and Health Act, 29 CFR Section 1926.650), as shown in the Solicitation Documents or Contract Documents, Contractor shall comply in all respects with the detailed plans and specifications set out in applicable OSHA regulations, and all other applicable laws. Specific Trenching Requirements, of the regulations of the Occupational Safety and Health Administration. Contractor shall assume full responsibility for compliance with the

Occupational Safety and Health Administration regulations pertaining to trench safety systems. Contractor will be responsible for completion of additional detailed plans and specifications for trench safety to the extent that such detailed plans and specifications are necessary to supplement the provisions of these General Conditions.

- D. Neither explosives nor blasting shall be permitted on the Project, except with the approval of the Owner upon recommendation of the Architect/Engineer.
- E. Contractor shall designate in writing a qualified and experienced safety representative (the "Safety Representative") at the Project site whose duties and responsibilities shall include safety training; identifying and mitigating hazardous conditions and unsafe work practices; and developing, maintaining and supervising the implementation of safe work practices and safety programs as deemed necessary and appropriate for the Project. The Safety Representative shall exercise due diligence in the execution of all Project related safety duties. The Safety Representative shall report directly to an officer of the Contractor, not to Contractor's on site Project Manager or Superintendent. Upon request of Owner, Contractor shall provide certifications or other acceptable documentation of the Safety Representative's qualifications. The following requirements will be effective as of March 1, 2016:
  - 1. The Safety Representative shall present to Owner certification of completion for both the Safety Representative and Superintendent of the OSHA 30-hour Construction Industry Training Outreach Program described at:  
[http://www.osha.gov/dte/outreach/construction\\_generalindustry/construction.html](http://www.osha.gov/dte/outreach/construction_generalindustry/construction.html)
  - 2. The Safety Representative shall verify that all construction workers (defined as persons covered by a prevailing wage determination) on the Project site, whether employed by the Contractor or subcontractors, have completed the OSHA 10-hour Construction Industry Training Outreach Program described at:  
[http://www.osha.gov/dte/outreach/construction\\_generalindustry/construction.html](http://www.osha.gov/dte/outreach/construction_generalindustry/construction.html). The Safety Representative must receive a certificate of training completion before allowing a worker on site and shall submit a copy of such certificate to the Owner in the form of a submittal.
  - 3. The Safety Representative shall ensure that workers, including those designated competent persons, have completed all applicable OSHA specific or other training needed to perform their job assignments. Training topics applicable to the scope of the current Project may include, but are not limited to, scaffolds, fall protection, cranes, excavations, electrical safety, tools, concrete and masonry construction, steel erection, operation of motor vehicles and mechanized equipment.

4. The Safety Representative shall ensure that all required OSHA and Workers' Compensation notices to workers are posted in English and Spanish at one or more conspicuous locations on the work site.

#### 9.4 SCHOOL SAFETY REQUIREMENTS

- A. When Work is to be performed at a Project site in which school activities are being conducted, Contractor shall take special care, and shall require its subcontractors, and all persons performing Work at the site to take special care, to protect the safety and welfare of the students, teachers, employees, and visitors at the school, and to perform the Work with as little disruption to the learning environment and school activities as possible.
- B. When Work is to be performed at a Project site where school activities are being conducted, it is expressly understood and agreed that Contractor's and any subcontractor's employees and other persons performing Work at the Project site shall not engage in any inappropriate interaction of any nature whatsoever with students, teachers, employees and visitors at the school, including talking, touching, staring, or in any way contributing to a hostile or offensive environment. It is further expressly understood and agreed that there is to be no fraternization between Contractor's and any subcontractor's employees, and other persons performing Work at the site, and students, teachers, employees and visitors at the school. There shall be zero tolerance for violations of these provisions.
- C. The possession or use of tobacco products, alcoholic beverages, illegal drugs, and firearms or weapons on Owner's property is prohibited at all times, twenty-four hours a day. There shall be zero tolerance for violations of this provision.
- D. Contractor, subcontractors, and all other persons performing Work in connection with the Project shall strictly observe (i) all school bus safety laws and other written requirements, (ii) speed limits in the vicinity of the Project site, including, without limitation, school speed limits, and (iii) any posted speed limits on the Project site established by Owner. Contractor shall require strict compliance with this provision.
- E. Contractor, subcontractors and all other persons performing Work at the Project site shall use only such access to the site and facilities as are designated by Owner, and shall comply with all other rules and requirements established by Owner for use or occupancy of the Project site.
- F. Owner shall have the right to require the immediate removal from the Project site of any person performing Work who violates the provisions of this Section 9.4, and to prohibit such person from being allowed to perform Work at the Project site in the future.



- G. A Contractor who fails to enforce compliance with the provisions of this Section 9.4, or who suffers or allows an employee, subcontractor or other person performing Work at the Project site to violate any of these provisions, shall be in breach of this Contract.
- H. Contractor shall prominently post at the job site these requirements and any other rules or regulations required by law or established by Owner for the safety and protection of students, teachers, school employees and visitors or for the performance of Work at the Project site. Such rules or requirements shall constitute a part of the requirements under the Contract Documents for the performance of the Work, and the Contractor's failure to observe or enforce these requirements shall constitute a default under the Contract.

#### 9.5 LOCATION AND PROTECTION OF UTILITIES

- A. Notwithstanding any other provisions of the Contract, the Contractor shall be solely responsible for location and protection of any and all public lines and utility customer service lines in the Work area. Locations of utilities shown on plans are approximate only and do not necessarily indicate all utilities that may be encountered during construction or their exact location. Failure of a utility to be indicated or an incorrect location on information provided to Contractor by Owner or Architect/Engineer does not relieve the Contractor of responsibility to determine the locations of all lines and utilities and protect utility lines as provided herein. The Contractor shall notify "One Call" (1-800-344-8377), and exercise due care to locate and to mark, uncover or otherwise protect all such lines within the limits of construction and any of the Contractor's work or storage areas. Upon request, the Owner shall provide such information as known about the location and grade of water, sewer, gas, telephone, electric and other utilities in the work area, but such information shall not relieve the Contractor's obligation hereunder, which shall be primary and not delegable.

#### 9.6 ASBESTOS

- A. Contractor will not commence Work until Contractor has received from Owner information identifying the location(s) of asbestos containing materials within the areas of the Work at the Project site.
- B. In the event the Contractor encounters on the site material reasonably believed to be asbestos which has not been rendered harmless, the Contractor shall immediately stop work in the area affected and report the condition to the Owner and Architect/Engineer in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner and Contractor if in fact the material is asbestos and has not been rendered harmless. The Work in the affected area shall be resumed, by written agreement of the Owner and Contractor, in the absence of asbestos or when it has been rendered harmless.

- C. The Contractor shall comply with all applicable provisions and requirements of federal, state and local laws and regulations on removal and/or encapsulation of asbestos in public schools, including 15 USCA sections 2641 *et seq.*; 40 CFR part 763; TEX. REV. CIV. STAT. art. 4477-3a; and 25 TEX. ADMIN. CODE § 295.31 *et seq.* as the same may be modified or amended from time to time or superseded by other laws.
- D. Remediation or removal of asbestos-containing materials shall only be conducted in accordance with all applicable laws, and performed by a licensed or certified asbestos abatement contractor. Such person must maintain insurance, including environmental liability insurance, in accordance with the requirements set forth herein.
- E. Contractor shall not knowingly install asbestos or asbestos containing materials into the Work.

## 9.7 HAZARDOUS SUBSTANCES

- A. Prior to commencement of the Work, Owner will provide all reports in its possession or control relating to the environmental condition of the Project site and Contractor shall be responsible for determining whether any environmental condition impacts the Contractor's Work, and for promptly notifying Owner and Architect/Engineer of any such impact. Contractor shall notify Owner and Architect/Engineer in writing as soon as possible, but in no event later than 5 days after Contractor becomes aware that hazardous materials, or suspected hazardous materials are located on the Project site or in connection with the Work and that such materials may impact the Contractor's Work. Contractor shall not disturb asbestos-containing materials or any environmental condition, unless such Work is within the scope of services to be performed by Contractor, and is performed in accordance with applicable law by duly licensed or certified professionals.
- B. If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a hazardous 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/Engineer in writing. In the event the Contractor encounters on the site material that Contractor knows, or reasonably believes to be a hazardous substance which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and Architect/Engineer in writing.
- C. 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. When the material or substance has been rendered harmless, Work in the

affected area shall resume. If Work is delayed by hazardous materials that were not known to be present at the Project site, the Contract Time and/or Contract Amount shall be equitably adjusted by Change Order in accordance with the provisions of the Contract, provided the hazardous material or substance or clean-up requirements were not caused by Contractor or any subcontractor or supplier, or person for whom Contractor is liable and notice of the conditions was timely given to Owner as provided herein.

- D. Contractor agrees that it shall not transport to, use, generate, dispose of or install at the Project site any hazardous substance (as defined herein), except in accordance with applicable Environmental Laws. Further, in performing the Work, the Contractor shall not cause any release of hazardous substances into, or contamination of, the environment, including the soil, the atmosphere, any water course or ground water, except in accordance with applicable Environmental Laws. In the event the Contractor engages in any of the activities prohibited in this Section, to the fullest extent permitted by law, the Contractor hereby indemnifies, defends and holds harmless Owner and all of its officers, trustees, directors, agents and employees from and against any and all claims, damages, losses, causes of action, suits and liabilities of every kind, including but not limited to, expenses of litigation, court costs, punitive damages and attorneys' fees, arising out of, incidental to or resulting from the activities prohibited in this Section. These obligations are in addition to any other indemnification obligations provided by the Contract Documents and shall survive termination of the Contract or completion of Contractor's obligations under the Contract as to events occurring prior to such termination or completion.
- E. For purposes of this Contract, the term "hazardous substance" or "hazardous materials" shall mean and include, but shall not be limited to, any element, constituent, chemical, substance, compound or mixtures, which are defined in or included under or regulated by any local, state or federal law, rule, ordinance, by-law or regulation pertaining to environmental regulation, contamination, clean-up or , including without limitation The Comprehensive Environmental Response, Compensation and Liability Act of 1980 ("CERCLA"), The Resource Conservation and Recovery Act ("RCRA"), The Toxic Substances Control Act ("TSA"), The Clean Water Act ("CWA"), The Clean Air Act ("CAA"), The Marine Protection Research and Sanctuaries Act ("MPRSA"), the Occupational Safety and Health Act ("OSHA"), The Superfund Amendments and Reauthorization Act of 1986 ("SARA"), or other state superlien or environmental clean-up or statutes, including all state and local counterparts of such laws (all such laws, rules and regulations, as amended from time to time, being referred to collectively as "Environmental Laws"). It is the Contractor's responsibility to comply with this Section 9.7 based on the law in effect at the time its services are rendered and to comply with any amendments to those laws, for all services rendered after the effective date of any such amendments.

- A. Prior to commencement of any Work on the Project site, Contractor shall deliver to Owner for review a copy of Contractor's written safety program manual ("Safety Program Manual"). The Safety Program Manual must describe in detail Contractor's entire safety program and the specific responsibilities of those involved, and shall include, without limitation, table of contents, safety rules/policies/procedures, references to all OSHA requirements and other applicable Federal, State and local safety laws, rules and regulations, Hazard Communication Program (but do not include Material Safety Data Sheets), method of providing safety training for all of Contractor's jobsite employees, subcontractor safety and requirements/enforcement. Prior to the commencement of any Work on the Project site, the Safety Program Manual must have been received and reviewed by Owner.

## 9.9 CONTRACTOR'S SAFETY PLAN

- A. Prior to commencement of any Work on the Project site, Contractor shall deliver to Owner for review a written safety plan for the Project ("Safety Plan") that will provide a safe environment for all workers, and which complies with, but is not limited to, the following guidelines. The Contractor is responsible for reviewing the specific requirements of the Contract, analyzing the planned methods of operation, and incorporating any additional specific or unique safety requirements in the written plan. The Contractor is solely responsible for ensuring that all applicable safety regulations are addressed as part of the Safety Plan. Prior to the commencement of any Work on the Project site (i) the Safety Plan must have been received and reviewed by Owner, and (ii) the Safety Plan must be in place and fully operational.
- B. General Provisions -- The Safety Plan shall include, but not be limited to, the following elements:
1. evacuation plans as may be required;
  2. emergency response procedures;
  3. identification of the Contractor's safety representative and all other designated individuals responsible for administering the Safety Plan;
  4. safety provisions developed by the Contractor for its normal operation of construction activities or any specific provisions being employed for special construction activities; and
  5. all other provisions necessary to properly protect all workers, the school population, and the Owner's employees and representatives carrying out their normal activities and duties at the Project site.

## 9.10 EMERGENCIES

- A. In an emergency affecting safety of persons or property, where Contractor does not have time to contact the Owner's Project Manager or Architect/Engineer, or where such persons cannot be reached, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation and/or extension of time claimed by the Contractor on account of its response to an emergency that is not due to Contractor fault or negligence of Contractor or persons performing the Work on Contractor's behalf shall be determined by Architect/Engineer and Owner as provided under the provisions of this Contract regarding Change Orders.

## 9.11 OFFSITE WORK

- A. The Contractor and its subcontractors shall utilize appropriate safety measures in performing such offsite work in public ways and sidewalks including, without limitation, obtaining and establishing adequate traffic barriers and installing appropriate signage, having sufficient trained personnel to direct vehicular and pedestrian traffic and hiring police as required to properly and safely conduct such Work. Such measures shall be designed so as to allow the Contractor and its subcontractors to properly carry out the required work in public ways and sidewalks while minimizing safety problems and disruption to the public using such public ways and sidewalks, all in compliance with applicable laws and regulations.

# **Article 10. INSURANCE AND BONDS**

## 10.1 REQUIRED INSURANCE COVERAGE

- A. Contractor shall provide insurance coverages and comply with the terms described in Subsections 10.1 through 10.6 (and 10.7 and/or 10.8 if applicable) for all Work required by the Contract through the end of the warranty period (with the exception of Builders' Risk). Contractor shall also maintain any extended coverage required herein for insurance coverage authorized to be provided on a claims made basis.
- B. Contractor shall require each subcontractor to provide the insurance coverage described in Subsection 10.4 in accordance with the provisions of Subsections 10.1 and 10.2, and to provide the certificate of coverage for worker's compensation insurance described in Subsection 10.4. Subcontractors performing environmental remediation or abatement or transportation of hazardous materials must provide the insurance required in Subsections 10.3 through 10.7 (except that Builders' Risk shall not be required if not available for the services performed by such subcontractor) and must comply with Subsections 10.1 and 10.2. Subcontractors performing professional services as described in Subsection 10.8 must comply with the insurance coverage required by such subsection and with Subsections 10.1 and 10.2. All required insurance must be provided through the end of the warranty period (with the exception of Builders' Risk). Subcontractors must maintain such

other insurance as Contractor may require. If Subcontractor is insured under a policy on a claims made basis, Contractor shall require such coverage to remain in effect for at least three (3) years.

- C. The required insurance must be provided prior to the commencement of services or Work under the Contract, and must be provided at all times throughout the term of the Contract, as herein provided.
- D. Contractor shall require each subcontractor to maintain commercially reasonable insurance coverage in connection with the Project as well as the insurance specifically required herein.
- E. The Contractor's and any subcontractor's failure to comply with any of these provisions constitutes a breach of contract by the Contractor which entitles Owner to pursue the rights and remedies set forth in the Contract Documents if the Contractor does not remedy the breach within ten days after receipt of notice of breach from Owner.

## 10.2 GENERAL REQUIREMENTS

- A. Contractor shall carry insurance in the types and amounts specified herein, which shall include coverage for items owned by Owner in the care, custody and control of Contractor prior to and during construction and warranty period.
- B. Contractor must complete and forward to Owner a certificate or certificates of insurance on forms approved or deemed approved by the Texas Department of Insurance under Chapter 1811 of the Texas Insurance Code and provided or approved by Owner ("Certificate of Insurance," whether one or more) and all required endorsements before the Contract is executed, as verification of all coverage required below. Contractor and subcontractors shall not commence Work until the required insurance is obtained and until such insurance has been reviewed and approved by Owner. Maintenance of insurance by the Contractor and approval of insurance by Owner shall not relieve or decrease the liability of Contractor hereunder and shall not be construed to be a limitation of liability on the part of Contractor. Contractor must also complete and forward a Certificate of Insurance to Owner whenever a previously identified policy period has expired as verification of continuing coverage. Contractor must provide the Certificate of Insurance to Owner showing the extended or replacement coverage prior to the date for expiration of the policy or policies shown on the Certificate of Insurance held by Owner.
- C. Contractor's and subcontractor's insurance coverage is to be written by companies licensed to do business in the State of Texas at the time the policies are issued and shall be written by companies with A.M. Best ratings of A VII or better unless otherwise approved by the Owner. If an insurance company becomes insolvent or goes into receivership or liquidation, the Contractor or subcontractor affected shall

provide the required insurance coverage from an alternate insurer that meets the requirements of this Contract.

- D. All endorsements naming the Owner as additional insured, waivers, and notices of cancellation endorsements as well as the Certificate of Insurance shall indicate the Owner as: Austin Independent School District, 1111 West 6th Street, Austin, Texas 78703 Attn: Executive Director, Department of Construction Management.
- E. If insurance policies are not written for amounts specified below, Contractor or subcontractor shall carry Umbrella or Excess Liability Insurance for any differences in amounts specified. If Excess Liability Insurance is provided, it shall follow the form of the primary coverage.
- F. Owner shall be entitled, upon request and without expense, to receive certified copies of policies and endorsements thereto and may make any reasonable requests for deletion or revision or modification of particular policy terms, conditions, limitations, or exclusions except where policy provisions are established by law or regulations binding upon either of the parties hereto or the underwriter on any such policies.
- G. Owner reserves the right to review the insurance requirements set forth during the effective period of this Contract and to make reasonable adjustments to insurance coverage, limits, and exclusions when deemed necessary and prudent by Owner based upon changes in statutory law, court decisions, the claims history of the industry or financial condition of the insurance company as well as Contractor.
- H. Contractor and subcontractors shall not cause any required insurance to be canceled nor permit any insurance to lapse during the term of the Contract or as required in the Contract Documents.
- I. Contractor and subcontractors shall be responsible for premiums, deductibles and self-insured retentions, if any, stated in policies. All deductibles or self-insured retentions shall be disclosed on the Certificate of Insurance.
- J. Contractor shall provide Owner thirty (30) days written notice of erosion of the aggregate limits below occurrence limits for all applicable coverages indicated within the Contract.
- K. If Owner owned property is being transported or stored off-site by Contractor, then the appropriate property policy will be endorsed for transit and storage in an amount sufficient to protect Owner's property.
- L. The insurance coverages required under this Contract are required minimums and are not intended to limit the responsibility or liability of Contractor, or to prevent Contractor from maintaining greater coverage, or from requiring greater coverage from its subcontractors, should Contractor so choose.

- M. Contractor and each subcontractor shall use a Certificate of Insurance form provided or approved by Owner.
- N. If the Owner is damaged by the failure or neglect of the Contractor or a subcontractor to purchase or maintain insurance as required by the Contract Documents, then the Contractor shall bear all costs attributable to or resulting from such failure, and shall be liable to Owner for any loss or liability that Owner sustains as a result of such failure or neglect. This obligation shall survive termination or completion of the Contract as to any failure or neglect to obtain or maintain insurance during the period required by the Contract Documents.

#### 10.3 BUSINESS AUTOMOBILE LIABILITY INSURANCE.

- A. Provide coverage for all owned, non-owned and hired vehicles. The policy shall contain the following endorsements in favor of Owner:
  - 1. Waiver of Subrogation endorsement in favor of Owner;
  - 2. 30 day Notice of Cancellation endorsement; and
  - 3. Additional Insured endorsement naming Owner as an additional insured.
- B. Provide coverage with a minimum combined single limit of \$1,000,000 per occurrence for bodily injury and property damage. Alternate acceptable limits are \$500,000 bodily injury per person, \$1,000,000 bodily injury per accident and at least \$250,000 property damage liability each accident.

#### 10.4 WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY INSURANCE

- A. Coverage shall be consistent with statutory benefits outlined in the Texas Workers' Compensation Act (Title 5, Subtitle A, Texas Labor Code). Contractor shall assure compliance with this Statute by submitting two (2) copies of a standard certificate of coverage (e.g. ACCORD form) to Owner for every person providing services on the Project as acceptable proof of coverage. The Owner's Certificate of Insurance No. 104 must be presented as evidence of coverage for Contractor. Workers' Compensation Insurance coverage written by the Texas Mutual Insurance Company (f/k/a Texas Workers Compensation Insurance Fund) is acceptable to Owner. Contractor's policy shall apply to the State of Texas and include these endorsements in favor of Owner:
  - 1. Waiver of Subrogation in favor of Owner; and
  - 2. 30 day Notice of Cancellation.
- B. The minimum policy limits for Employers' Liability Insurance coverage shall be



\$500,000 bodily injury each accident, \$500,000 bodily injury by disease policy limit and \$500,000 bodily injury by disease each employee.

C. Definitions:

1. Certificate of coverage (“certificate”) - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the Texas Department of Insurance (“TDI”), or a coverage agreement (DWC-81, DWC-82, DWC-83, or DWC-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.
2. Duration of the Project - includes the time from the beginning of the Work on the Project until the Project has been finally completed and accepted by Owner and any warranty period has terminated.
3. Persons providing services on the Project (“subcontractor” in §406.096 of the Texas Labor Code) - 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 contracted directly with the Contractor and 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 which furnishes persons to provide services on the Project. “Services” include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to the Project. “Services” does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

D. Workers’ Compensation policies shall include waivers of subrogation as against Owner, its officers, trustees and employees.

E. 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, Section 401.011(44) for all employees of the Contractor providing services on the Project, for the duration of the Project.

F. The Contractor must provide a certificate of coverage to Owner prior to being awarded the Contract.

G. 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 Owner showing that coverage has been extended prior to the expiration date of the coverage.

- H. The Contractor shall obtain from each person providing services on the Project, and provide to Owner:
1. a certificate of coverage, prior to that person beginning work on the Project, so Owner will have on file certificates of coverage showing coverage for all persons providing services on the Project; and
  2. no later than seven 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.
- I. The Contractor shall retain all required certificates of coverage for the duration of the Project and for one year thereafter.
- J. The Contractor shall notify Owner in writing by certified mail or personal delivery, within 10 days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project.
- K. The Contractor shall post on each Project site a notice, in the text, form and manner prescribed by the TDI, 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. The required posting is set out below in Article 18.
- L. The Contractor shall contractually require each person with whom it contracts to provide services on the Project, to:
1. provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of the Texas Labor Code, Section 401.011(44) for all of its employees providing services on the Project, for the duration of the Project;
  2. 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;
  3. 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;
  4. obtain from each other person with whom it contracts, and provide to the Contractor: (a) a certificate of coverage, prior to the other person beginning work on the Project; and (b) a new certificate of coverage showing

extension of coverage, prior to the end of the coverage period, if the coverage period shown the current certificate of coverage ends during the duration of the Project;

5. retain all required certificates of coverage on file for the duration of the Project and for one year thereafter;
  6. notify Owner 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 provision of coverage of any person providing services on the Project; and
  7. contractually require each person with whom it contracts to perform as required by items 1–6 of this Subsection 10.4.L, with the certificates of coverage to be provided to the person for whom they are providing services.
- M. By signing this Contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to Owner 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 a self-insured, with the TDI'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.
- N. The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles Owner to pursue the rights and remedies set forth herein (including the right to declare the Contract void) if the Contractor does not remedy the breach within ten days after receipt of notice of breach from Owner.

#### 10.5 COMMERCIAL GENERAL LIABILITY INSURANCE.

- A. The Policy shall contain the following provisions:
1. Contractual liability coverage for liability assumed under the Contract and all contracts relative to the Project.
  2. Products/Completed Operations coverage for the duration of the warranty period.
  3. Contractors/Subcontractors Work coverage.
  4. Aggregate limits of insurance per project endorsement.

5. Additional Insured Endorsement naming Owner as an additional insured. Such coverage shall provide for Owner to be covered against claims arising out of construction operations and completed operations without further restriction and such coverage shall be endorsed to be primary and non-contributory insurance coverage to Owner.
  6. 30 day notice of cancellation, nonrenewal or substantial modification in favor of Owner.
  7. Waiver of Transfer of Recovery Against Others in favor of Owner.
- B. Provide coverage with a minimum combined bodily injury and property damage per occurrence limit of \$2,000,000, and a general aggregate limit of \$4,000,000, products/completed operations aggregate limit of \$4,000,000, and Personal and Advertising Injury limit of \$2,000,000. The policy shall be amended so that the completed operations/products aggregate shall apply on a per project basis.

#### 10.6 BUILDERS' RISK INSURANCE

- A. Contractor shall maintain Builders' Risk Insurance or Installation Insurance on an all risk physical loss form in the Contract Amount. Owner shall be a loss payee on the policy. If off-site storage is permitted, coverage shall include transit and storage in an amount sufficient to protect property being transported or stored. At Owner's election, such coverage shall continue in effect until the Work is accepted by Owner even if the Project is occupied and put to its intended use prior to such acceptance.

#### 10.7 HAZARDOUS MATERIALS INSURANCE

- A. For projects which include lead abatement instead of asbestos abatement, substitute "lead" for "asbestos" in the following paragraphs. For projects which include lead and asbestos abatement, change the word "asbestos" in the following paragraphs to read "lead and asbestos."
- B. For Work which involves asbestos or any hazardous materials or pollution defined as asbestos, Contractor or subcontractor responsible for the Work shall comply with the following insurance requirements in addition to those specified above:
1. Provide an asbestos abatement endorsement to the Commercial General Liability policy with minimum bodily injury and property damage limits of \$1,000,000 per occurrence and products/completed operations coverage with a separate aggregate of \$1,000,000. This policy shall not exclude asbestos or any hazardous materials or pollution defined as asbestos, and shall provide "occurrence" coverage without a sunset clause. The policy shall provide 30 day Notice of Cancellation and Waiver of Subrogation endorsements in favor of Owner.

2. Contractor or subcontractor responsible for transporting asbestos or any hazardous materials defined as asbestos shall provide pollution coverage as required by law and the Contract Documents. Federal law requires interstate or intrastate transporters of asbestos to provide an MCS 90 endorsement with a \$5,000,000 limit when transporting asbestos in bulk in conveyances of gross vehicle weight rating of 10,000 pounds or more. Interstate transporters of asbestos in non-bulk in conveyances of gross vehicle weight rating of 10,000 pounds or more must provide an MCS 90 endorsement with a \$1,000,000 limit. The terms “conveyance” and “bulk” are defined by Title 49 CFR 171.8. All other transporters of asbestos shall provide either an MCS 90 endorsement with minimum limits of \$1,000,000 or an endorsement to their Commercial General Liability Insurance policy which provides coverage for bodily injury and property damage arising out of the transportation of asbestos. The endorsement shall, at a minimum, provide a \$1,000,000 limit of liability and cover events caused by the hazardous properties of airborne asbestos arising from fire, wind, hail, lightning, overturn of conveyance, collision with other vehicles or objects, and loading and unloading of conveyances.
3. Contractor shall submit complete copies of the policy providing pollution liability coverage to Owner.

## 10.8 PROFESSIONAL LIABILITY INSURANCE

- A. For Work or services which require professional engineering or professional survey services to meet the requirements of the Contract, including but not limited to trench safety systems, traffic control plans, and construction surveying, abatement plans, the Contractor or subcontractors responsible for performing the professional services shall provide Professional Liability Insurance with a minimum limit of \$1,000,000 per claim and in the aggregate to pay on behalf of the assured all sums which the assured shall become legally obligated to pay as damages by reason of any negligent act, error, or omission committed with respect to all professional services provided in due course of the Work of this Contract.
- B. The policy shall include a 30 day Notice of Cancellation endorsement in favor of Owner and shall be occurrence based. If the policy is claims made, the retroactive date shall coincide with the date of this Contract. The Certificate of Insurance shall state that this coverage is claims made and shall give the retroactive date. Coverage shall be continuous or contain an extended reporting period for not less than 12 months beyond the expiration of the warranty period.

## 10.9 BONDS

- A. Prior to commencement of Work hereunder, Contractor will (if the Contract amount exceeds \$25,000.00) provide a Performance Bond and a Payment Bond, each in the penal amount of 100% of the Contract Amount, conditioned that Contractor will

faithfully perform all Contractor's undertakings in this Contract and will fully pay all persons furnishing labor and material in the prosecution of the Work provided for in this Contract. Such Performance Bond and Payment Bond shall be on forms supplied by Owner, issued by a corporate Surety licensed to do business in Texas that is listed on the U.S. Treasury list of approved sureties as provided in Subsection 10.9 B. If any surety upon any bond becomes insolvent, is in receivership, is unable to perform its obligations, or otherwise ceases to do business in this State, the Contractor shall promptly furnish Owner with substitute bonds or equivalent security satisfactory to Owner to protect the interests of Owner and of persons furnishing labor and materials in the prosecution of the Work.

- B. All bonds furnished by Contractor must comply with Chapter 2253, Texas Government Code, including the requirement that such bonds must be executed by a corporate surety licensed to do business in Texas in accordance with Article 7.19-1, Texas Insurance Code. Such bonds shall be on forms supplied or approved by Owner. Surety shall be listed as an approved surety by the U. S. Treasury Department, if the bond amount is \$400,000 or more or as required by Owner in accordance with applicable law. If any surety on any bond becomes insolvent or is unable to perform its obligations thereunder, the Contractor shall immediately furnish replacement bonds or equivalent security acceptable to Owner to protect the interests of Owner and persons furnishing labor and materials to the Project.

#### 10.10 ADDITIONAL BOND REQUIREMENTS IF CONTRACT AMOUNT IS NOT ESTABLISHED WHEN CONTRACT IS SIGNED

- A. If a fixed Contract Amount or Guaranteed Maximum Price has not been determined at the time the Contract is signed by the Contractor, the penal sums of the Performance and Payment Bonds delivered to Owner must each be in an amount equal to the Estimated Project Budget, as specified for each project in the Owner's Solicitation Documents. The Contractor shall deliver the bonds to Owner not later than the 5<sup>th</sup> day after the date the Contractor executes the Contract, unless Owner expressly agrees in writing to accept from the Contractor a bid bond, proposal bond or other financial security acceptable to Owner to ensure that the Contractor will furnish the required Performance and Payment Bonds at the time the Contract Amount or Guaranteed Maximum Price is established.
- B. If Owner agrees to accept a bid bond, proposal bond or other financial security in lieu of Payment and Performance bonds in connection with Contractor's execution of the Contract, then Contractor must provide Payment and Performance Bonds at the same time Contractor executes and delivers to Owner an amendment to the Contract furnished by Owner establishing a Guaranteed Maximum Price for, as applicable, (i) the first phase of the Work described in such amendment, if the Project will be performed in two or more phases, or (ii) the final Guaranteed Maximum Price for the Work described in such amendment, if the Project is not phased. The Payment and Performance Bonds must each be in the amount of 100% of the Contract Amount or Guaranteed Maximum Price as established in such amendment, or the Estimated Project Construction Budget, as specified in the Agreement, whichever is greater. If Payment and Performance Bonds are provided

by Contractor before the final Guaranteed Maximum Price is established, Contractor will, as necessary, provide Owner with endorsements or replacement bonds so that the penal amount of each Bond is equal to 100% of the final Guaranteed Maximum Price, within 5 days after the final Guaranteed Maximum Price is agreed to by Owner and Contractor, as evidenced by the execution of an amendment to the Contract establishing the final Guaranteed Maximum Price.

#### 10.11 WAIVER OF SUBROGATION

- A. Contractor and Owner waive all rights of recovery against the other party and such party's employees, officers, agents and Board members, for damages resulting from fire, or other causes of loss, but only to the extent the damages are covered by insurance proceeds actually received and applied to the payment of such damages, from insurance coverage required to be maintained under this Contract or other insurance coverage which is available to respond to such loss. Nothing in this provision will be deemed to waive any party's right to insurance proceeds.

### **11. Article 11. INSPECTIONS, TESTS AND CORRECTION OF WORK**

#### 11.1 TIMES AND PLACES

- A. Except as otherwise provided in this Contract, inspection and test by Owner of material and workmanship required by this Contract shall be made at reasonable times and at the site of the Work, unless the Owner upon consultation with the Architect/Engineer determines that such inspection or test of material which is to be incorporated in the Work shall be made at the place of production, manufacture, or shipment of such.

#### 11.2 CONTINUING RESPONSIBILITY

- A. Except as otherwise specified by the Owner upon advice of the Architect/Engineer at the time of determining to make an inspection or test, no inspection or test shall relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of Owner after acceptance of the completed Work.

#### 11.3 INSPECTIONS AND TESTING

- A. All inspections and tests which may be required by the building codes and ordinances of the city where the Project site is located, or if in no city, the closest city, will be performed in conformance with applicable law, at Contractor's expense (except as otherwise provided by applicable law), whether or not the Project site is within the corporate limits of that city.

- B. By law, Owner is required to provide or contract separately with a third party to provide for the construction materials engineering, testing, and inspection services and the verification testing services necessary for acceptance of the Work by Owner. Contractor shall not include costs for these services in the Cost of the Work.

#### 11.4 REJECTED MATERIAL OR WORK

- A. The Contractor shall, without charge, promptly replace any material or correct any workmanship found by Owner or Architect/Engineer not to conform to the Contract requirements, unless in the public interest Owner consents to accept such material or workmanship with an appropriate adjustment in Contract Amount. The Contractor shall promptly segregate and remove rejected material from the premises.
- B. The Contractor will be charged with the additional cost of any test or inspection of the replaced material or corrected workmanship.
- C. If the Contractor does not promptly replace rejected material or correct rejected workmanship, it shall be a material default under the Contract and Owner may (1) notwithstanding any provision of Section 13.3.A to the contrary, by contract or otherwise, immediately commence to replace such material or correct such workmanship and charge the cost thereof to the Contractor, or (2) pursue its rights and remedies under the Contract in accordance with Article 13.

#### 11.5 COOPERATION

- A. The Contractor shall furnish promptly, without additional charge, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Architect/Engineer. All inspections and tests by Owner shall be performed promptly. Special, full-size, and performance tests shall be performed as described in this Contract. The Contractor shall be charged with any additional cost of inspection when material and workmanship are not ready at the time specified by the Contractor for its inspection.



## 11.6 COVERED WORK

- A. Should it be considered necessary or advisable by Owner at any time before acceptance of the entire Work to make an examination of Work already completed, by removing or tearing out same, the Contractor shall, on request, promptly furnish all necessary facilities, labor and material. If such Work shall have been covered without the approval of the Architect/Engineer, or if such Work is found to be defective or nonconforming in any material respect due to the fault of the Contractor, subcontractors or anyone furnishing labor or materials under this Contract, Contractor shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such Work is found to meet the requirements of the Contract, an equitable adjustment shall be made in the Contract Amount to compensate the Contractor for the additional services involved in such examination and reconstruction and, if completion of the Work has been delayed thereby, Contractor shall, in addition, be granted a suitable extension of time.

## Article 12. MISCELLANEOUS PROVISIONS

### 12.1 THIRD PARTIES

- A. All provisions of this Contract shall be binding upon and inure to the benefit of Owner, Contractor and their respective successors and assigns, but Contractor shall not assign this Contract in whole or in part, nor assign any monies due or to become due hereunder, without in each case the prior written consent of Owner. No provision of this Contract shall inure to the benefit of any third party that is neither an approved assignee nor a successor of Owner or of the Contractor.

### 12.2 BANKRUPTCY

- A. It is recognized that (i) if any order for relief is entered on behalf of or against the Contractor pursuant to Title 11 of the United States Code, (ii) if any other similar order is entered under any other debtor relief laws, (iii) if the Contractor makes a general assignment for the benefit of its creditors, or (iv) if a receiver is appointed for the benefit of creditors, or (v) if a receiver is appointed on account of its insolvency, any such event could impair or frustrate the Contractor's performance of the Contract Documents. Accordingly, it is agreed that upon the occurrence of any such event, the Owner, in addition to other rights and remedies hereunder, shall be entitled to request the Contractor or its successor in interest to provide 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 after delivery of the request shall entitle the Owner to terminate the Contract or Contractor's right to perform thereunder, to make demand on the Surety to perform the Contractor's obligations, and to any other enforceable rights set forth in the Contract Documents.

- B. In all events, pending receipt of adequate assurance of performance and actual performance in accordance therewith, the Owner shall be entitled to make demand on the Surety or proceed with the Work with its own forces or with other contractors on a time and materials or other appropriate basis, the cost of which will be backcharged against the Contract Amount. If such costs and damages exceed the unpaid balance, the Contractor shall be obligated to 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/Engineer, upon application, and this obligation for payment shall survive termination of the Contract. To the extent the costs of completing the Work, including compensation for additional professional services (including but not limited to attorney's fees) and expenses, exceed those costs which would have been payable to the Contractor to complete the work except for the Contractor's default, the Contractor will pay the difference to the Owner, subject to any rights of the Surety, if the Surety performs Contractor's obligations, and this obligation for payment shall survive termination or completion of the Contract Documents. Such costs incurred by the Owner will be determined by the Owner and confirmed by the Architect/Engineer.
- C. Any provision in this Section 12.2 regarding the obligations of Contractor for the payment of amounts or the performance of obligations is subject to Contractor's rights under Federal law and nothing in this Section is intended to constitute an assertion of a debt in violation of any such rights.

### 12.3 NONWAIVER OF DEFAULT

- A. Any failure by Owner at any time, or from time to time, to require strict compliance with or to enforce any of the terms or conditions of this Contract shall not constitute a waiver of any such terms or conditions nor shall it affect or impair Owner's ability to require strict compliance with such terms or conditions in the future, or the right of Owner at any time to avail itself of such remedies as it may have for any breach or breaches of any such term or condition. An express waiver by Owner of any specific act of nonperformance or default shall not constitute a waiver of any subsequent acts of nonperformance or default.

### 12.4 SEVERABILITY

- A. If any provision of the Contract shall be determined to be invalid, unlawful or unenforceable, this Contract shall be reformed to the greatest extent necessary to make the offending provision valid and enforceable, or if this offending provision cannot be modified so as to be valid and enforceable, this Contract shall be reformed so as to exclude the offending provision from this Contract if it can be done without destroying the benefit of the bargain between the parties. As so reformed, the Contract shall be binding upon and enforceable by both Owner and the Contractor. No additional consideration shall be due to either party by reason of any such reformation.

## 12.5 CONSTRUCTION

- A. The Contract Documents shall not be construed more or less favorably between the parties by reason of authority or origin of language.

## 13. Article 13. TERMINATION OR SUSPENSION OF THE CONTRACT

### 13.1 SUSPENSION OF THE WORK FOR OWNER'S CONVENIENCE

- A. Owner or the Architect/Engineer may order the Contractor in writing to suspend, delay or interrupt all or any part of the Work for such period of time as it may determine to be appropriate for the convenience of Owner.
- B. If the performance of all or any part of the Work is suspended by Owner for its convenience, through no fault of Contractor and for reasons other than an event of Force Majeure, by an act of a Contracting Officer in the administration of this Contract, for a cumulative period of time of more than 60 days during the term of this Contract, then Contractor shall be entitled to an equitable adjustment to the Contract Time and/or for any increase in the cost of performance of this Contract (excluding profit) necessarily caused by a suspension which is in excess of the 60 days herein provided, and the Contract modified in writing accordingly by Change Order.
- C. However, no adjustment shall be made under this clause for any suspension to the extent (1) that performance would have been suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor, or (2) for which an equitable adjustment is provided for or excluded under any other provision of this Contract.

### 13.2 RESPONSIBILITY FOR COMPLETION

- A. The Contractor shall furnish such manpower, materials, facilities and equipment and shall work such hours, including night shifts, overtime operation and Sundays and holidays, as may be necessary to insure the progress of the Work in accordance with the approved Construction Schedule and the completion of the Work within the Contract Time. If Work falls behind the currently updated and approved Construction Schedule and it becomes apparent from the current schedule that the Work will not be completed within the Contract Time, the Contractor agrees that the Contractor will take some or all of the following actions as deemed necessary by the Owner to substantially eliminate the backlog of work and complete the Project within the Contract Time:
  - 1. Increase manpower in such quantities and crafts as will substantially eliminate, in the opinion of the Owner, the backlog of work;

2. Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of equipment, or any combination or the foregoing sufficient to substantially eliminate, in the opinion of the Owner, the backlog of work; and
  3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities.
- B. The Owner may require the Contractor to submit a recovery schedule demonstrating the Contractor's program and proposed plan to make up the lag in scheduled progress and to ensure completion of the Work within the Contract Time. If the Owner and Architect/Engineer find the proposed plan not acceptable, they may require the Contractor to submit a new plan. If the actions taken by the Contractor or the second plan proposed are not satisfactory, the Owner may require the Contractor to take any or all of the actions set forth in Section 13.2.A to make up the lag in scheduled progress.
- C. Failure of the Contractor to substantially comply with the requirements of this Section 13.2 may be considered grounds for a determination by the Owner, that the Contractor is failing to prosecute the Work with sufficient diligence to ensure its completion within the Contract Time as required by Section 3.1.A.
- D. If Contractor's failure to meet the time periods provided in the approved Construction Schedule or other delay in the performance of the Work is due to Contractor's unexcused delay, the Contractor shall perform the services required by this Section 13.2 at no additional cost to Owner. If Owner determines that the failure or delay is due in part to Contractor's unexcused delay and in part to other causes which are not the fault of Contractor or for which Contractor is not responsible, the additional costs attributable to the acceleration of the Work required under this Section 13.2 shall be equitably allocated between Contractor and the Owner, provided however, that nothing in this provision is intended to waive or limit Owner's right to pursue claims against any third party for the additional cost of the Work allocated to Owner.
- E. Any provision in the Contract Documents to the contrary notwithstanding, in the event Contractor would be entitled to an extension of time under the provisions of the Contract, Owner shall have the right, instead of awarding additional time, to require Contractor to accelerate the Work, as provided in this Section, and Owner shall pay Contractor for the reasonable additional costs incurred by Contractor that are attributable to such acceleration, as provided by Change Order.

### 13.3 EVENTS OF DEFAULT

- A. Contractor will be in default under this Contract if Contractor fails to prosecute the Work diligently, in a timely manner and in accordance with the Contract Documents, or fails to timely comply with or perform any other obligation(s) under

the terms of the Contract, and such default continues after Owner provides Contractor with written notice of default and opportunity to cure as herein provided. Unless a longer notice period is required by law, Owner shall give Contractor 10 days written notice and opportunity to cure. In the event of an emergency condition, where the Contractor's breach or the failure to cure the default presents an imminent threat to the safety of persons or property, Owner may exercise its rights and remedies under this Contract if Contractor does not cure the default within 3 days after notice of default is given, including the right to perform the curative work, and to charge Contractor for the costs incurred by Owner.

- B. Owner will be in default under this Contract if Owner commits a default under the terms of this Contract, and fails to cure such default within ten days after written notice by Contract or within such longer time period as may be provided by law. Provided, however, that if the default is one that cannot be reasonably cured within such time period, Owner shall not be deemed in default if Owner commences the cure within the stated notice period, and diligently pursues the cure to completion. The notice of default and time periods provided by this Section shall be in addition to any other notice and cure periods provided by the Contract Documents.
- C. Any provision in this Contract to the contrary notwithstanding, upon a default by Contractor, Owner shall have, in addition to any rights or remedies provided by the Contract Documents, all rights and remedies available at law or equity. All such rights and remedies are cumulative, and not exclusive, and may be exercised by Owner independently, concurrently or successively.
- D. Upon a default by Owner, Contractor will have the rights provided by law or equity, subject to the provisions of the Contract, including those set forth in Article 14.
- E. In the event either party files suit in connection with the Contract Documents or the Project, the prevailing party shall be entitled to Court costs and reasonable attorney's fees.

#### 13.4 TERMINATION FOR CONVENIENCE OF OWNER

- A. The performance of Work under this Contract may be terminated by Owner in whole, or from time to time in part, whenever Owner shall determine that such termination is in the best interest of Owner. Any such termination shall be effected by delivery to the Contractor of a written notice of termination ("Notice of Termination") specifying the extent to which performance of Work under the Contract is terminated and the date upon which such termination becomes effective.
- B. After receipt of a Notice of Termination, the Contractor shall cooperate fully with Owner in minimizing the cost to Owner of such termination and shall, as directed by a Contracting Officer, protect the Work accomplished and properties acquired for performance of the Work, terminate or cancel incomplete subcontracts and purchase orders, and dispose of surplus materials and other properties.

- C. In the event of such a termination, the Contract Amount shall be equitably adjusted to a sum which shall fairly compensate the Contractor for all Work completed and for all costs incurred (net of salvage) in part performance of the incomplete portions of the Work and for all costs incurred in connection with the termination, but exclusive of profit on the incomplete portions of the Work. In no event shall such sum be less than the portion of the Contract Amount allotted to the completed portion of the Work.
- D. No amount shall be allowed the Contractor hereunder unless, within ninety-one days after all compensable costs of Contractor shall have become liquidated and determinable, and not thereafter, Contractor shall submit in writing to the Executive Director of Construction Management Contractor's claim in the amount stated with such supporting particulars as the Executive Director of Construction Management may request.

#### 13.5 TERMINATION FOR CONTRACTOR'S DEFAULT

- A. If the Contractor is in default under this Contract, and the default has extended beyond the cure period provided in this Contract, then Owner may, by written notice to the Contractor and without notice to Contractor's Surety, terminate this Contract or terminate Contractor's right to proceed with the Work under the Contract. In such event Owner may take over the Work and prosecute the same to completion, by contract or otherwise, and may take possession of and utilize in completing the Work such materials, equipment, machinery, tools, and supplies as may be on the site of the Work and necessary therefore. Owner may also make demand on the Surety to perform Contractor's obligations under the Contract. Whether or not the Contractor's right to proceed with the Work is terminated, Contractor and Contractor's Surety shall remain liable for any damage to Owner resulting from Contractor's refusal or failure to complete the Work within the specified time.
- B. If Owner should so terminate the Contractor's right to proceed, or the Contract, the resulting damages recoverable by Owner will include liquidated damages for delay as may be specified in the Agreement or other Contract Documents until Substantial Completion of the Work, together with any increased cost or expenses incurred by Owner in so completing the Work or curing the default.
- C. If, after notice of termination of the Contract or Contractor's right to proceed under the provisions of this Section 13.5, it is determined for any reason that the Contractor was not in default under the provisions of the Contract, or that the delay was excusable under the provisions of Article 7 hereof, the rights and obligations of the parties shall be the same as if the Notice of Termination had been issued pursuant to Article 13 concerning termination for the convenience of Owner.

#### 14. Article 14. ADMINISTRATIVE PROCEDURE FOR CONTRACTOR CLAIMS

#### 14.1 ADMINISTRATIVE PROCEDURE FOR RESOLUTION OF CLAIMS

- A. No claim by the Contractor for additional time or for additional compensation (including damages) shall be allowed unless it is timely presented to Owner and Architect/Engineer in writing, together with appropriate detailed supporting documentation, as provided by the terms of the Contract Documents and the provisions of this Article 14.
- B. Contractor must notify Owner and Architect/Engineer of its claim in writing (a) within 21 days (or such later period as may be required by law) after occurrence of the event giving rise to a claim or (b) within 21 days (or such later period as may be required by law) after the Contractor first recognizes, or should have recognized, the condition giving rise to the claim, whichever is later. Within 20 days of submitting a claim, Contractor must provide complete and detailed documentation concerning the nature and amount of the claim, to the extent that such information is reasonably available. Failure to comply with the requirements of this Subsection 14.01.B constitutes a waiver of Contractor's claim.
- C. Any claim by the Contractor for additional time or for additional compensation shall be presented by Contractor to Owner first as a request for a Change order to adjust the Contract Time and/or Contract Amount as provided in Article 6, and shall be approved or rejected by the Executive Director of Construction Management.
- D. If the Executive Director of Construction Management should reject a claim of the Contractor so presented, or if he should fail to approve it within sixty days after presentment by Contractor to the Executive Director of all required information and supporting documentation, the Contractor may appeal in writing to the Board of Trustees of AISD. The Decision of the Executive Director of Construction Management shall be final and binding unless the Contractor takes such an appeal within twenty days after the date of the decision by the Executive Director of Construction Management. Contractor shall comply with the terms of any written appeal procedure established by Owner.
- E. If the Board of Trustees of AISD should reject the Contractor's claim, or if the Board of Trustees should reject the Contractor's claim within ninety days after it is timely filed with the Board as specified in Subsection 14.01.D, the Contractor's administrative remedy under this Contract shall be deemed to be exhausted.
- F. No suit shall be brought by the Contractor upon this Contract, or for breach of this Contract, until the administrative remedy set forth herein shall have been exhausted, nor more than two years after exhaustion of the administrative remedy. In addition, the Contractor agrees to mediate any such claim with Owner, in good faith, prior to filing suit against Owner in connection with such matters.

- G. During the pendency of any claim, the Contractor shall proceed diligently with the work as directed by the Executive Director of Construction Management.
- H. This Contract shall be construed in accordance with the laws of the State of Texas, and venue for any case or controversy arising under or pursuant to this Contract or in connection therewith, shall lie in courts of competent jurisdiction in Travis County, Texas, and in the federal courts of Austin, Texas.

**15. Article 15. PARTIAL USE OR OCCUPANCY**

- A. The Owner shall have the right to use and occupy spaces or systems and other portions of the Work prior to completion and acceptance of all the Work (including occupancy by a tenant, operator or anyone else occupying or using the Project with the Owner's consent, or to install furnishings and equipment). In addition, the Owner shall have the right to accept and operate Project systems in advance of Substantial Completion.
- B. If the Owner desires to exercise its right of partial occupancy or use as provided herein, the Contractor shall cooperate with the Owner in making available for the Owner's use building services such as heating, ventilating, cooling, water, lighting, power, elevator and telephone for the proposed use and health, safety and comfort of the users or occupants of the space or spaces and other parties present on or entering or leaving the site. If the equipment required to furnish such services is not entirely completed at the time the Owner desires to use or occupy aforesaid space or spaces, the Contractor shall make every reasonable effort to complete the same as soon as possible so that the necessary equipment can be put into operation and use.
- C. Mutually acceptable arrangements shall be made between the Owner and Contractor for procedures, terms, and conditions governing the operation and maintenance of such services and facilities as may be utilized for the benefit of the Owner prior to Substantial Completion. The Owner will assume the proportionate and reasonable responsibility for operation and cost of the systems, equipment and/or utilities required to provide such services.
- D. The Owner's early occupancy or use of any portion of the Work as described in this Article 15 shall not constitute the Owner's acceptance of any Work, materials or equipment which are not in conformity with the requirements of the Contract Documents, nor relieve the Contractor from its obligations to complete the Work, or its responsibility for loss or damage due to or arising out of defects in, or malfunctioning of systems, equipment, material or any element of the Work, or from any unfulfilled obligations or responsibilities under the Contract Documents.
- E. The Contractor shall make no claim for delay or extension of the Contract Time or for damages of any kind arising directly or indirectly out of the exercise by the Owner of the rights reserved under this Article 15.



**16. Article 16. TAXES**

- A. The Contract Amount shall be deemed to include all taxes payable in connection with the Work.
- B. Owner is a tax exempt entity and Contractor shall take all steps required by applicable law to purchase materials, equipment and services free from sales and other taxes in accordance with law, including compliance with procedures established by the Texas Comptroller. If Contractor fails to obtain such tax exemption on any materials and equipment, Contractor shall notify Architect/Engineer and Owner shall not be obligated to pay the amount of such taxes as part of the Cost of the Work.
- C. Unless otherwise provided by applicable law, the following items are exempt from tax in connection with this Contract:
  - 1. The purchase of personal property, (including machinery or equipment and its accessories and repair and replacement parts) for use in the performance of a Contract for an improvement to realty if the personal property is incorporated into realty in the performance of the Contract;
  - 2. The purchase of property, other than machinery or equipment and its accessories and repair and replacement parts, for use in the performance of a contract for an improvement to realty if the personal property is (a) necessary and essential for the performance of the contract and (b) completely consumed at the job site. Personal property is completely consumed if after being used once for its intended purpose, it is used up or destroyed. Personal property that is rented or leased for use in the performance of the Contract is not deemed to be completely consumed.
  - 3. The purchase of a taxable service for use in the performance of a contract for an improvement to realty if the service is performed at the job site, and if (a) the Contract expressly requires the specific service to be performed or (b) the service is integral to the performance of the contract.

**17. Article 17. NOTICE TO PARTIES**

- A. Unless otherwise provided in the Agreement, notice given under this Contract shall be in writing, and shall be deemed delivered upon deposit in the U. S. Mail (whether or not actually received) if addressed to the recipient at the address for notice set forth in the Contract Documents, and sent by registered or certified mail return receipt requested, postage prepaid, with copy sent concurrently by facsimile. Notice given in any other manner shall be deemed delivered if and when actually received. Contractor or Owner may change its address for notice by providing the other party with written notice of the change of address for notice given in the

manner provided by Article 17. Such change of address shall be effective 14 days after delivery of the notice.

## **18. Article 18. NOTICES REQUIRED TO BE POSTED AT PROJECT SITE**

### **18.01 JOB SITE POSTINGS**

A. Contractor shall post at the Project site in both English and Spanish, in a conspicuous place, any notices required by law to be posted there, and any notices required by the Owner in writing to be posted there, including the Notice of Prevailing Wage Rates, Important Information Notice regarding Owner contact for wage disputes or questions, Contractor's Notice regarding pledge of Equal Opportunity Employment and the following notices:

#### **1. Workers' Compensation Notice**

This notice must:

- (1) be posted in English, Spanish and any other language common to the employer's employee population;
- (2) be displayed on each project site;
- (3) state how a person may verify current coverage and report failure to provide coverage;
- (4) be printed with a title in at least 30-point bold type and text in at least 19-point normal type; and
- (5) contain the exact words as prescribed in Rule 110.110 (d)(7)

### **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 services related to the project, regardless of the identity of their employer or status as an employee.

Call the Division of Workers' Compensation at 1-800-252-7031 or access the division's website at [www.tdi.texas.gov/wc/indexwc.html](http://www.tdi.texas.gov/wc/indexwc.html) to receive information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage.

### **COBERTURA REQUERIDA DE COMPENSACIÓN PARA TRABAJADORES**

La ley requiere que cada persona que trabaja en este lugar o que proporciona servicios relacionados con este proyecto de construcción debe estar cubierta por un seguro de compensación para trabajadores. Esto incluye a personas que proporcionan, transportan, o entregan equipo o materiales, o que proporcionan mano de obra, u otros servicios relacionados con este proyecto, sin importar la identidad del empleador o el estado como empleado.

Comuníquese con la División de Compensación para Trabajadores al teléfono 1-800-252-7031 or access the division's website at [www.tdi.texas.gov/wc/indexwc.html](http://www.tdi.texas.gov/wc/indexwc.html) para recibir información referente a los requerimientos legales de cobertura, para verificar si su empleador ha proporcionado la cobertura requerida, o para reportar a un empleador que no proporciona cobertura.

## 2. Notice of AISD School Safety Rules

### AISD SCHOOL SAFETY RULES

(CONTRACTOR MUST POST AT PROJECT SITE WHERE SCHOOL ACTIVITIES ARE BEING CONDUCTED)

The following School Safety Rules must be followed at all times:

1. When Work is performed at a Project site in which school activities are being conducted, the Contractor, subcontractors and all persons working at the Project site must take special care to protect the safety and welfare of the students, teachers, employees, and visitors at the school.
2. Work must be performed with as little disruption to the learning environment and school activities as possible.
3. When Work is to be performed at a Project site where school activities are being conducted, it is expressly understood and agreed that Contractor's and any subcontractor's employees and other persons performing Work at the Project site shall not engage in any inappropriate interaction of any nature whatsoever with students, teachers, employees and visitors at the school, including talking, touching, staring, or in any way contributing to a hostile or offensive environment. It is further expressly understood and agreed that there is to be no fraternization between Contractor's and any subcontractor's employees, and other persons performing Work at the Project site, and students, teachers, employees and visitors at the school. There shall be zero tolerance for violations of these provisions.
4. The possession or use of tobacco products, alcoholic beverages, illegal drugs, and firearms or weapons on AISD property is prohibited at all times, twenty-four hours a day. There shall be zero tolerance for violations of this provision.

5. All persons performing work at the Project site must strictly observe:
  - school bus safety laws and requirements
  - speed limits in the vicinity of the Project site, including, school speed limits, and
  - any posted speed limits on the Project site established by AISD.
6. All persons performing Work at the Project site must use only the access to the site and facilities as are designated by AISD, and must comply with all other rules and requirements established by AISD for use or occupancy of the Project site.
7. AISD has the right to require the immediate removal from the Project site of any person performing Work that violates these rules and to prohibit such person from being allowed to perform work at the Project site in the future.

## **REGLAS ESCOLARES DE SEGURIDAD DE AUSTIN ISD**

(EL CONTRATISTA DEBE COLOCAR ESTA NOTIFICACIÓN EN UN LUGAR VISIBLE DEL SITIO DEL PROYECTO EN DONDE SE REALIZAN ACTIVIDADES ESCOLARES.)

Se deben seguir las siguientes Reglas Escolares de Seguridad en todo momento.

1. Cuando se realice algún trabajo en un sitio en el cual se llevan a cabo actividades escolares, el Contratista, los subcontratistas y todo el personal que labore en el sitio de trabajo deben tomar medidas especiales para proteger la seguridad y bienestar de los estudiantes, maestros, empleados y visitantes de la escuela.
2. El trabajo se debe realizar con la menor interrupción posible al ambiente de aprendizaje y a las actividades escolares.
3. Cuando el trabajo se hará en un sitio en donde se llevan a cabo actividades escolares, se entiende y se establece expresamente que los empleados de los contratistas y de los subcontratistas, además de otras personas realizando el trabajo en el sitio, no entablarán ninguna interacción inapropiada de naturaleza alguna con estudiantes, maestros, empleados y visitantes de la escuela, incluyendo hablar, tocar, ver fijamente o que de alguna manera contribuyan a un ambiente hostil u ofensivo. Asimismo se entiende expresamente y se está de acuerdo que no habrá relaciones amistosas y fraternales entre ninguno de los empleados de los contratistas y de los subcontratistas, ni entre ninguna otra persona que realiza el trabajo en el sitio, con estudiantes, maestros, empleados y visitantes a la escuela. Habrá cero tolerancia a la violación de estas provisiones.
4. Se prohíbe en todo momento la posesión o uso de productos de tabaco, bebidas alcohólicas, drogas ilegales y armas de fuego o de algún otro tipo, las 24 horas del día. Habrá cero tolerancia a la violación de esta provisión.

5. Todas las personas que realizan algún trabajo en el sitio deben acatar estrictamente lo siguiente:
  - las reglas y requisitos de seguridad de los autobuses escolares
  - la velocidad máxima en el área del sitio, incluyendo, los límites de velocidad escolar y
  - cualquier otro límite de velocidad establecido por Austin ISD en el sitio del proyecto
6. Todas las personas que realizan trabajos en el sitio del proyecto deben usar el acceso al sitio y a las instalaciones (demás edificios) según lo determine Austin ISD, y deberán apegarse a cualquier otra regla y requisito establecido por Austin ISD para el uso u ocupación del sitio del proyecto.
7. Austin ISD tiene el derecho de solicitar la remoción inmediata del sitio del proyecto de cualquier persona que realiza un trabajo y quien viola estas reglas, y de prohibir que a dicha persona se le permita realizar algún trabajo en el sitio del proyecto en el futuro.

**19. Article 19. PREVAILING WAGE RATES**

- A. Contractor and each subcontractor are responsible for complying with the applicable provisions of Chapter 2258 of the Texas Government Code regarding the payment of prevailing wage rates. Contractor and each subcontractor must pay wages to persons performing labor in connection with this Contract in an amount that is not less than the prevailing wage rates, including fringe benefits, for such workers applicable to the Project (as used herein, the term “worker” or “workers” includes laborers and mechanics).
- B. The prevailing wage rates applicable to the Project are set forth in the Notice of Prevailing Wage Rates for each of various classifications of construction workers. Pursuant to Chapter 2258 of the Texas Government Code, the Board of Trustees of AISD has ascertained and does specify that the general prevailing rate of per diem wages (for eight hours of work during regular working hours on a day not a Saturday or Sunday or holiday), in the locality in which the Work is to be performed is eight times the hourly base wage rate so listed for each respective craft or type of worker needed to execute the Contract and that the prevailing wage rate for legal holidays and overtime work (in excess of forty hours in such workweek) shall be not less than one and one-half times the hourly base wage rate.
- C. The Contractor shall pay, as a penalty to Owner, sixty dollars (\$60.00) for each worker employed for each calendar day or part of the day that such worker is paid less than the stipulated rate for any work done under this Contract by the Contractor or by any subcontractor under Contractor. Owner may withhold additional funds as appropriate when confronted with wage rate violations.

## **PROPOSAL/BID BOND**

KNOW ALL BY THESE PRESENTS: that the undersigned Principal and Surety are firmly bound to Austin Independent School District ("AISD") in the principal sum of:

\_\_\_\_\_ Dollars (\$\_\_\_\_\_).

Now the condition of this bond is this: that, whereas the undersigned principal has submitted to AISD a proposal or bid to enter into a certain contract whereunder principal undertakes to perform the following-described work of construction, alteration or repair for AISD Project No.

\_\_\_\_\_:

NOW, THEREFORE, if the principal shall, within ten (10) days following acceptance by the Board of Trustees of AISD of such proposal or bid and award by said Board to said principal of said contract, execute and return such further contract documents as may be required by the terms of the proposal or bid accepted, and within five (5) days after execution of such contract documents, deliver its safety program manual, the safety plan for the Project, and the bonds and insurance documents, as required by the terms of the proposal or bid accepted, then this obligation shall be null and void, otherwise it shall remain in full force and the amount hereof shall be paid to and retained by AISD as liquidated damages for principal's failure to do so.

Principal: \_\_\_\_\_

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

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

Surety: \_\_\_\_\_

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

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

## SECTION C

### SELF-PERFORMANCE EXPLANATION / JUSTIFICATION

Please complete the following to identify the scope of work required to fulfill your firm's contractual obligations to AISD and justify your firm's intention to self-perform all of the necessary work and duties required by the scope of the Project.

IDENTIFY THE REQUIRED SCOPE OF WORK FOR THE PROJECT		EXPLAIN HOW YOUR FIRM WILL SELF-PERFORM THE REQUIRED SCOPE

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

Printed Name: \_\_\_\_\_ Date: \_\_\_\_\_

# FELONY CONVICTION NOTICE FORM

Statutory citation covering notification of criminal history of contractor is found in the Texas Education Code §44.034.

## FELONY CONVICTION NOTIFICATION

State of Texas Legislative Senate Bill No. 1, Section 44.034, Notification of Criminal History, Subsection (a), states "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".

THIS NOTICE IS NOT REQUIRED OF A PUBLICLY-HELD CORPORATION

I, the undersigned agent for the firm named below, certify that the information concerning notification of felony convictions has been reviewed by me and the following information furnished is true to the best of my knowledge.

VENDOR'S NAME: \_\_\_\_\_

AUTHORIZED COMPANY OFFICIAL'S NAME: \_\_\_\_\_

A. My firm is a publicly-held corporation, therefore, this reporting requirement is not applicable.

**Signature of Company Official:** \_\_\_\_\_

B. My firm is not owned nor operated by anyone who has been convicted of a felony.

**Signature of Company Official:** \_\_\_\_\_

C. My firm is owned or operated by the following individual(s) who has/have been convicted of a felony.

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

(Attach additional sheet if necessary)

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

(attach additional sheet if necessary)

**Signature of Company Official:** \_\_\_\_\_



## **SUSPENSION AND DEBARMENT CERTIFICATION**

Federal Law (A-102 Common Rule and OMB Circular A-110) prohibits non-federal entities from contracting with or making subawards under covered transactions to parties that are suspended or debarred or whose principals are suspended or debarred. Covered transactions include procurement contracts for goods or services equal to or in excess of \$25,000 and all nonprocurement transactions (e.g., subawards to subrecipients).

Contractors receiving individual awards of \$25,000 or more and all subrecipients must certify that their organization and its principals are not suspended or debarred by a federal agency.

Before an award of \$25,000 or more can be made by your firm, you must certify that your organization and its principals are not suspended or debarred by a federal agency.

I, the undersigned agent for the firm named below, certify that neither this firm nor its principals are suspended or debarred by a federal agency.

VENDOR'S NAME: \_\_\_\_\_

Signature of Company Official: \_\_\_\_\_

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

Printed name of company official signing above: \_\_\_\_\_

**NOTICE OF PREVAILING WAGE RATES**  
**AISD PROJECT NO.: \_\_\_\_\_**

INFORMATION REGARDING PREVAILING WAGE RATES COMPLIANCE

1. Contractor and each subcontractor employed on the Project are responsible for complying with the Contract and the applicable provisions of Chapter 2258 of the Texas Government Code regarding the payment of prevailing wage rates.
2. **Contractor and each subcontractor employed on the Project are responsible for identifying any trade classifications and wage rates that are not listed on the prevailing wage rates and submit in writing upon execution of contract to the Executive Director of Construction Management Department at Austin Independent School District for approval and inclusion in the Project's prevailing wage rates.**
3. The Austin Independent School District shall assess, as a penalty, \$60.00 for each worker employed on the Project for each calendar day or part of the day that the worker is paid less than the wage rates stipulated for the Project, and withhold additional funds as appropriate when confronted with wage and benefit violations.
4. The Austin Independent School District has the right to request random samples of Contractor and subcontractor payrolls without warning.
5. The Austin Independent School District has the right to conduct random interviews of workers across various trades at the Project site with no warning.
6. This Notice, including the attached prevailing wage rates for the Project as published by the United States Department of Labor in accordance with the Davis-Bacon Act, and its subsequent amendments, shall be posted on the Project site and shall remain in effect for the duration of the Contract.

## PREVAILING WAGE RATES FOR THE PROJECT

**The applicable prevailing wage rates for the Project are attached to this Notice.**

The following shall be applicable to prevailing wage rates for the Project for apprentices and helpers:

- An apprentice may be charged at less than the journeyman wage stated in the applicable prevailing wage rates for the Project only if the apprentice is employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Department of Labor, or if the apprentice is employed within his/her first 90 days of probationary employment as an apprentice in such an apprenticeship program. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable prevailing wage rates.
- Helpers are not separately classified on the applicable prevailing wage rates for the Project. Thus, Contractors and subcontractors should assume that each worker will be classified under one of the existing job classifications on the attached. Contractors and subcontractors should not assume that any helper will be paid less than the journeyman wage for the most relevant job classification.

**AVISO DE TARIFAS SALARIALES VIGENTES**  
**NÚM. DEL PROYECTO DEL AISD**

INFORMACIÓN SOBRE EL CUMPLIMIENTO CON LAS TARIFAS SALARIALES VIGENTES

1. El contratista y cada subcontratista trabajando en el Proyecto son responsables de cumplir con el Contrato y las estipulaciones aplicables del Capítulo 2258 del Código Gubernamental de Texas tocante al pago de las tarifas salariales vigentes.
2. El contratista y cada uno de los subcontratistas empleados en el Proyecto son responsables de identificar las clasificaciones de oficios y las tarifas salariales que no estén listadas y enviarlas por escrito al llevar a cabo el contrato, al Director Ejecutivo del Departamento de Administración de la Construcción del Distrito Escolar Independiente de Austin para su aprobación e inclusión en las tarifas salariales vigentes del proyecto.
3. El Distrito Escolar Independiente de Austin deberá imponer, como una multa, \$60.00 por cada trabajador empleado en el Proyecto, por cada día o parte del día calendario donde al trabajador se le pague una cantidad menor que las tarifas salariales establecidas para el Proyecto, y se le retendrán fondos adicionales según corresponda cuando se encuentren violaciones de salarios y beneficios.
4. El Distrito Escolar Independiente de Austin tiene el derecho de solicitar al azar y sin previo aviso, muestras de nóminas de pago de Contratistas y subcontratistas.
5. El Distrito Escolar Independiente de Austin tiene el derecho de realizar al azar y sin previo aviso, entrevistas de trabajadores de varios oficios en el lugar del Proyecto.
6. Este Aviso, incluyendo las Tarifas Salariales Vigentes para el Proyecto según publicadas por el Departamento de Trabajo de los Estados Unidos bajo la Ley de Davis-Bacon, y sus enmiendas posteriores, deberán exhibirse en el lugar del Proyecto y permanecer vigentes el tiempo que dure el Contrato.

TARIFAS SALARIALES VIGENTES PARA EL PROYECTO

**Las tarifas salariales vigentes para el Proyecto se adjuntan a este Aviso.**

Lo siguiente será aplicable a tarifas salariales prevalecientes del Proyecto para aprendices y ayudantes:

- Se puede cobrar por un aprendiz un salario más bajo que el salario de un empleado especialista, estipulado en las tarifas salariales prevalecientes para el proyecto, solo si se emplea a un aprendiz de acuerdo con un programa de aprendizaje fidedigno en el que esté inscrito individualmente y que el programa esté registrado en el Departamento de Trabajo de los EE. UU., Administración de Empleo y Capacitación, Oficina de Adiestramiento en aprendizaje, Empleador y Servicios Laborales, o en una Agencia reconocida por el Departamento del Trabajo, o bien si al aprendiz se le emplea dentro de sus primeros 90 días de empleo a prueba como aprendiz en esa clase de programa de aprendizaje. A todo aprendiz debe pagársele según una tarifa no menor que la especificada en el programa registrado para el nivel de progreso del aprendiz, expresado como porcentaje del salario por hora del empleado especialista, especificado en las tarifas salariales prevalecientes aplicables.
- Los ayudantes no se clasifican por separado en las tarifas salariales prevalecientes aplicables al proyecto. Por lo tanto, los contratistas y subcontratistas deben presuponer que cada trabajador estará clasificado dentro de una de las clasificaciones de empleo existentes en el adjunto. Los contratistas y subcontratistas no deben presuponer que a cualquier ayudante se le pagará menos que el salario de empleado especialista para la clasificación de empleo más relevante.

## NOTICE

# **NOTICE OF PROVIDER OF WORKFORCE SCREENING SERVICES**

As per Sections 3.15 and 3.16 of the General Conditions of the Contract for Construction (the "General Conditions"), notice is given that the Austin Independent School District ("AISD") has contracted with FC Background, LLC (the "Provider") to provide certain workforce screening services, including badging, for all workers on all construction projects, including both "covered employees" and "non-covered employees".

The anticipated costs of Texas Department of Public Safety ("DPS") and FC Background, LLC ("FCB") services are at the expense of the Contractor and are to be incorporated in your proposal/bid for AISD projects.

### **DEPARTMENT OF PUBLIC SAFETY**

**NOTE: Screening services provided by FCB are separate from and in addition to the criminal history record information to be obtained from DPS by Contractor and each subcontractor for "covered employees" pursuant to Section 3.15.B of the General Conditions.**

**Contact the DPS Crime Records Service at (512) 424-5079 for instructions on obtaining national criminal history record information.**

### **F C BACKGROUND, LLC**

**NOTE: FCB screening services regarding "covered employees" will commence only after FCB receives a copy of the required List of Covered Employees that is attached to the Contractor Certification provided by Contractor to FCB pursuant to Section 3.15.E of the General Conditions. FCB services regarding "non-covered employees" will commence only after FCB receives a copy of the required List of Non-covered Employees provided by Contractor to FCB pursuant to Section 3.16.D of the General Conditions.**

**Contact FC Background for Contractor and subcontractor screening, drug testing and badging instructions.**

**Contact Information for FCB (Monday – Friday 6:00am – 6:00pm CST):**

**Frank Childress, Program Manager | [frank.childress@fcbbackground.com](mailto:frank.childress@fcbbackground.com) | (832) 277-0719**

**FC Background, Customer Support | [customer.support@fcbbackground.com](mailto:customer.support@fcbbackground.com) | (800) 388-8827**

# Austin Independent School District

## CERTIFICATE OF INSURANCE

5622788  
 TEXAS DEPT. OF INSURANCE  
 AUSTIN, TEXAS  
 APPROVED  
 MAY 12 2016

This Certificate shall be completed by a licensed insurance agent:

Name and Address of Agency: \_\_\_\_\_

AISD Reference: \_\_\_\_\_

\_\_\_\_\_

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

\_\_\_\_\_

Project Mgr.: \_\_\_\_\_

Phone: \_\_\_\_\_ / Fax: \_\_\_\_\_

Project No.: \_\_\_\_\_

Name and Address of Insured: \_\_\_\_\_

**Insurers Affording Coverages:**

\_\_\_\_\_

Insurer A: \_\_\_\_\_

\_\_\_\_\_

Insurer B: \_\_\_\_\_

Phone: \_\_\_\_\_ / Fax: \_\_\_\_\_

Insurer C: \_\_\_\_\_

Vendor/Sole Proprietor: \_\_\_\_\_

Insurer D: \_\_\_\_\_

Type of Vendor (from Matrix): \_\_\_\_\_

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YYYY)	POLICY EXPIRATION DATE (MM/DD/YYYY)	LIMITS OF LIABILITY	
	<b>Commercial General Liability Policy</b> Does the Policy include coverage for:				Each Occurrence	\$
					General Aggregate	\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Completed Operations/Products				Completed Operations/ Products – Aggregate	\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Blanket Contractual Liability				Personal & Advertising Injury	\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Explosion, Collapse, Underground				Deductible or Self Insured Retention	\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Medical Payment					\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Sex Molestation and Child Abuse (SAM)					\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Contractors/Subcontractors Work					\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Fire/Legal					\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Aggregate Limits per Project					\$
<input type="checkbox"/> Yes <input type="checkbox"/> No    -- Additional Insured					\$	
<input type="checkbox"/> Yes <input type="checkbox"/> No    -- 30 Day Notice of Cancellation					\$	

	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Waiver of Subrogation		\$
	Other Coverage		\$
	<b>Pollution/ Environmental Impairment Policy</b>	Occurrence	\$
		Aggregate	\$

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YYYY)	POLICY EXPIRATION DATE (MM/DD/YYYY)	LIMITS OF LIABILITY			
	<b>Auto Liability Policy</b> Which of the following are provided coverage:				CSL	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Any Auto				Bodily Injury (Per Accident)	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- All Owned Autos				Bodily Injury (Per Person)	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Property Damage (Per Accident)				Property Damage (Per Accident)	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Non-Owned Autos							
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Hired Autos							
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Waiver of Subrogation							
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- 30 Day Notice of Cancellation							
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Additional Insured							
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- MCS 90							
	<b>Excess Liability</b> <input type="checkbox"/> Umbrella Form <input type="checkbox"/> Excess Liability Follow Form						Occurrence	\$
							Aggregate	\$
	<b>Workers' Compensation and Employers' Liability</b> Does the policy include the following endorsements:				<input type="checkbox"/> Statutory			
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Waiver of Subrogation				Each Accident	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Disease – Policy Limit				Disease – Policy Limit	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Disease – Each Employee				Disease – Each Employee	\$		
	<b>Is a Builder Risk/Property/IM/ Installation Insurance policy provided?</b> <input type="checkbox"/> Yes <input type="checkbox"/> No				\$	\$		
	<input type="checkbox"/> Yes <input type="checkbox"/> No   -- Is AISD shown as loss payee/mortgagee?							
	<b>Professional Liability</b>				Each Claim	\$		

	<input type="checkbox"/> 30 Day Notice of Cancellation Retroactive Date: _____				Deductible or Self Insured Retention	\$
--	---	--	--	--	---	----

This form is for informational purposes only and certifies that policies of insurance listed above have been issued to insured named above and **are in force at this time**. Notwithstanding any requirements, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, insurance afforded by policies described herein is subject to all terms, exclusions and conditions of such policies.

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

**CERTIFICATE HOLDER:**

Austin Independent School District  
1111 West 6<sup>th</sup> Street  
Austin, Texas 78703

\_\_\_\_\_  
AUTHORIZED REPRESENTATIVE SIGNATURE  
Licensed Insurance Agent



**PAYMENT BOND**

STATE OF TEXAS

Bond No. \_\_\_\_\_

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

Project No. \_\_\_\_\_

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

Know All Men By These Presents: That \_\_\_\_\_

of the City of \_\_\_\_\_, County of \_\_\_\_\_ and

State of \_\_\_\_\_, as Principal, and \_\_\_\_\_

a solvent corporation authorized under laws of the State of Texas to act as Surety on bonds for principals, are held and firmly bound unto \_\_\_\_\_ (Owner), and all Subcontractors, workers, laborers, mechanics and suppliers as their interests may appear, all of whom shall have right to sue upon this bond in the penal sum of \_\_\_\_\_ U.S. Dollars

(\$ \_\_\_\_\_ U.S.), for payment whereof, well and truly to be made, said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

Conditions of this Bond are such that, whereas, Principal has entered into a certain written contract with Owner; dated the \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ to which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied in length herein.

Now, therefore, condition of this obligation is such, that if the said Principal shall well and truly pay all Subcontractors, workers, laborers, mechanics, and suppliers, all monies to them owing by said Principals for subcontracts, work, labor, equipment, supplies and materials done and furnished for the construction of improvement of said Agreement, then this obligation shall be and become null and void; otherwise to remain in full force and effect.

Provided, however, that this bond is executed pursuant to provisions of Chapter 2253, Texas Government Code as amended and all liabilities on bond shall be determined in accordance with provisions of said Article to same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that any change in Contract Time or Contract Sum shall not in anywise affect its obligation on this bond, and it does hereby waive notice of any such change in Contract Time or Contract Sum.

In witness whereof, said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Surety

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

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

Title: \_\_\_\_\_

Title: \_\_\_\_\_

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

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

Name and address of the Resident Agent of Surety:

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

Note: Bond shall be issued by a solvent Surety company authorized to do business in Texas, and shall meet any other requirements established by law or by Owner pursuant to applicable law. A copy of surety agent's "Power of Attorney" must be attached hereto.

**PERFORMANCE BOND**

STATE OF TEXAS

Bond No. \_\_\_\_\_

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

Project No. \_\_\_\_\_

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

Know All Men By These Presents: That \_\_\_\_\_  
of the City of \_\_\_\_\_, County of \_\_\_\_\_, and State of \_\_\_\_\_,  
as Principal, and \_\_\_\_\_

a solvent company authorized under laws of the State of Texas to act as Surety on bonds for principals, are held and firmly bound unto \_\_\_\_\_ (Owner), in the penal sum of \_\_\_\_\_ U.S. Dollars (\$ \_\_\_\_\_ U.S.) for payment whereof, well and truly to be made, said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

Conditions of this Bond are such that, whereas, Principal has entered into a certain written contract with OWNER, dated the \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

Now, therefore, the condition of this obligation is such, that if said Principal shall faithfully perform said Agreement and shall in all respects duly and faithfully observe and perform all and singular covenants, conditions and agreements in and by said contract agreed and covenanted by Principal to be observed and performed, and according to true intent and meaning of said Agreement hereto annexed, then this obligation shall be void; otherwise to remain in full force and effect.

Provided, however, that this bond is executed pursuant to provisions of Chapter 2253, Texas Government Code as amended and all liabilities on this bond shall be determined in accordance with provisions of said Article to same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that any change in Contract Time or Contract Sum shall not in anywise affect its obligation on this bond, and it does hereby waive notice of any such change in Contract Time or Contract Sum.

In witness whereof, said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_

Principal	Surety
By: _____	By: _____
Title: _____	Title: _____
Address: _____	Address: _____
_____	_____
_____	_____
	Telephone: _____ Fax: _____
	E-Mail Address: _____

Name and address of Resident Agent of Surety:  
\_\_\_\_\_  
\_\_\_\_\_

Note: Bond shall be issued by a solvent Surety company authorized to do business in Texas, and shall meet any other requirements established by law or by Owner pursuant to applicable law. A copy of surety agent's "Power of Attorney" must be attached hereto.

**NOTICE OF REQUIRED WORKERS'  
COMPENSATION COVERAGE  
(Contractor Must Post at Project Site)**

**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.

Call the Division of Workers' Compensation at 512-804-4345 to receive information on the legal requirement for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage.

**COBERTURA REQUERIDA DE COMPENSACIÓN PARA TRABAJADORES**

La ley requiere que cada persona que trabaja en este lugar o que proporciona servicios relacionados con este proyecto de construcción debe estar cubierta por un seguro de compensación para trabajadores. Esto incluye a personas que proporcionan, transportan, o entregan equipo o materiales, o que proporcionan mano de obra, u otros servicios relacionados con este proyecto, sin importar la identidad del empleador o el estado como empleado.

Comuníquese con la División de Compensación para Trabajadores al teléfono 512-804-4345 para recibir información referente a los requerimientos legales de cobertura, para verificar si su empleador ha proporcionado la cobertura requerida, o para reportar a un empleador que no proporciona cobertura.

**(MUST BE POSTED ON PROJECT SITE)**

# **AISD SCHOOL SAFETY RULES**

**AISD PROJECT NO. \_\_\_\_\_**

## **(CONTRACTOR MUST POST AT PROJECT SITE WHERE SCHOOL ACTIVITIES ARE BEING CONDUCTED)**

The following School Safety Rules must be followed at all times:

1. When work is performed at a Project site in which school activities are being conducted, the Contractor, Subcontractors and all persons working at the Project Site must take special care to protect the safety and welfare of the students, teachers, employees, and visitors at the school.
2. Work must be performed with as little disruption to the learning environment and school activities as possible.
3. When Work is to be performed at a Project site where school activities are being conducted, it is expressly understood and agreed that Contractor's and any subcontractor's employees and other persons performing Work at the Project site shall not engage in any inappropriate interaction of any nature whatsoever with students, teachers, employees and visitors at the school, including talking, touching, staring, or in any way contributing to a hostile or offensive environment. It is further expressly understood and agreed that there is to be no fraternization between Contractor's and any subcontractor's employees, and other persons performing Work at the site, and students, teachers, employees and visitors at the school. There shall be zero tolerance for violations of these provisions.
4. The possession or use of tobacco products, alcoholic beverages, illegal drugs, and firearms or weapons on AISD property is prohibited at all times, twenty-four hours a day. There shall be zero tolerance for violations of this provision.
5. All persons performing work at the Project site must strictly observe:
  - school bus safety laws and requirements
  - speed limits in the vicinity of the Project site, including, school speed limits, and
  - any posted speed limits on the Project site established by AISD.
6. All persons performing Work at the Project site must use only the access to the site and facilities as are designated by AISD, and must comply with all other rules and requirements established by AISD for use or occupancy of the Project site.
7. AISD has the right to require the immediate removal from the Project site of any person performing work who violates these rules and to prohibit such person from being allowed to perform work at the Project site in the future.

# REGLAS ESCOLARES DE SEGURIDAD DE AUSTIN ISD

(EL CONTRATISTA DEBE COLOCAR ESTA NOTIFICACIÓN EN UN LUGAR VISIBLE DEL SITIO DEL PROYECTO EN DONDE SE REALIZAN ACTIVIDADES ESCOLARES.)

Se deben seguir las siguientes Reglas Escolares de Seguridad en todo momento.

1. Cuando se realice algún trabajo en un sitio en el cual se llevan a cabo actividades escolares, el Contratista, los Subcontratistas y todo el personal que labore en el sitio de trabajo deben tomar medidas especiales para proteger la seguridad y bienestar de los estudiantes, maestros, empleados y visitantes de la escuela.
2. El trabajo se debe realizar con la menor interrupción posible al ambiente de aprendizaje y a las actividades escolares.
3. Cuando el trabajo se hará en un sitio en donde se llevan a cabo actividades escolares, se entiende y se establece expresamente que los empleados de los contratistas y de los subcontratistas, además de otras personas realizando el trabajo en el sitio, no entablarán ninguna interacción inapropiada de naturaleza alguna con estudiantes, maestros, empleados y visitantes de la escuela, incluyendo hablar, tocar, ver fijamente o que de alguna manera contribuyan a un ambiente hostil u ofensivo. Asimismo se entiende expresamente y se está de acuerdo que no habrá relaciones amistosas y fraternales entre ninguno de los empleados de los contratistas y de los subcontratistas, ni entre ninguna otra persona que realiza el trabajo en el sitio, con estudiantes, maestros, empleados y visitantes a la escuela. Habrá cero tolerancia a la violación de estas provisiones.
4. Se prohíbe en todo momento la posesión o uso de productos de tabaco, bebidas alcohólicas, drogas ilegales y armas de fuego o de algún otro tipo, las 24 horas del día. Habrá cero tolerancia a la violación de esta provisión.
5. Todas las personas que realizan algún trabajo en el sitio deben acatar estrictamente lo siguiente:
  - las reglas y requisitos de seguridad de los autobuses escolares
  - la velocidad máxima en el área del sitio, incluyendo, los límites de velocidad escolar y
  - cualquier otro límite de velocidad establecido por Austin ISD en el sitio del proyecto
6. Todas las personas que realizan trabajos en el sitio del proyecto deben usar el acceso al sitio y a las instalaciones (demás edificios) según lo determine Austin ISD, y deberán apegarse a cualquier otra regla y requisito establecido por Austin ISD para el uso u ocupación del sitio del proyecto.
7. Austin ISD tiene el derecho de solicitar la remoción inmediata del sitio del proyecto de cualquier persona que realiza un trabajo y quien viola estas reglas, y de prohibir que a dicha persona se le permita realizar algún trabajo en el sitio del proyecto en el futuro.

# CONTRACTOR INSTRUCTIONS FOR ISSUANCE OF KEYS AND ACCESS

1. General Contractors (GCs) or Construction Managers at Risk (CMs@Risk) shall give the Department of Construction Management (CM) Project Manager (PM) at least two (2) days prior notice of interest in obtaining a Single-School Master set, a District-wide Master set or Portable Master set for a project. AISD PM will notify AISD Service Center of contractor's need for keys at least two (2) days prior to contractor pickup.
2. Contractors can pick up and return keys Monday-Friday between **7:45 A.M. and 4:00 P.M. at the AISD Service Center, 5101 East 51<sup>st</sup> Street, phone #414-5476 or #414-3298.** (Call before arriving)
  - a. All contractors are required to fill out and sign a key contract form and contractor information form (giving the contractor's name, location, phone number and anticipated period of work, name, address, and emergency contact phone numbers of contractor supervisory personnel involved with the project, acknowledging receipt of keys and withholding penalty amounts.) As authorized by the Project Manager after the contract is executed, keys will be issued to GCs and CMs@Risk only – not to subcontractors.
  - b. At Project Close-Out, contractors will return all keys. If, in the assessment of the Service Center, any key is missing, the PM will calculate the *withholding penalty in the following amounts: Single-School Master keys are \$2,500 per set. Portable keys are \$1,000 per set. District-wide Master keys are \$5,000 per set.* All keys are required to be returned for Close-Out of the Project.

Contractors who will be working inside an AISD facility will be issued an intrusion alarm system code number by their AISD Project Manager, who will give instructions in how to disarm and rearm the alarm system by entering the code number in the keypad on site in the building. Contractor shall obtain the alarm code from the Project Manager, **Monday through Friday, between 8:00 A.M. and 4:00 P.M.** Contractor shall give the AISD Project Manager at least one day's prior notice of intention to get an alarm code. The contractor will be responsible for unlocking the door and disarming the alarm system when entering the building as well as for arming the alarm system and locking the exterior door when leaving the building. Contractor shall notify AISD Police at 414-1703 before entering a building and disarming the alarm system, and shall notify AISD Police again before leaving the building and rearming the alarm system. ***Failure to follow these procedures will require that a police officer be sent to the site, and withholding in the amount of \$50.00 will be charged for the cost of each such police call or failure to lock doors at the end of the workday.***

4. All Contractors & subcontractors working on AISD Property must wear an identification badge which includes the name, company and picture of the worker. Worker must have also completed a criminal background check.

**You can direct any wage disputes or questions to:**

**Austin Independent School District  
Department of Construction Management  
812 San Antonio, Suite 200  
Austin, Texas 78701 (512) 414-8940**

***According to Government Code Title 10, Chapter 2258, "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 to a worker employed by it in the execution of the contract."***

**Puede dirigir sus preguntas o disputas sobre salario a:**

**Distrito Escolar Independiente, de Austin  
Departamento de Gerencia de Construcción  
812 San Antonio, Suite 200  
Austin, Texas 78701 (512) 414-8940**

***De acuerdo con el Título 10 del Código del Gobierno, Capítulo 2258,  
"El contratista al que le fue adjudicado un contrato por una entidad  
pública, o su subcontratista, deberán pagar a un trabajador  
contratado, un salario no menor que las tarifas determinadas bajo la  
Sección 2258, para la ejecución del contrato".***



# CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

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## 1. PROJECT INFORMATION

Facility:

DISTRICT:

Address:

ARCHITECT/ENGINEER:

City:

CONTRACTOR / CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

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## 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.

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3. **The District** certifies that the education program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer:

DISTRICT:

BY:

DATE:

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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 Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER:

BY:

DATE:

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**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/CM:**

**BY:**

**DATE:**

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**6. The District** certifies completion of the project (as defined by the architect/engineer and contractor).

**DISTRICT:**

**BY:**

**DATE:**

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### **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
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- 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 §61.1033 or §61.1036, 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.

# CERTIFICATE OF SATISFACTION OF BILLS

THE STATE OF TEXAS      ™

™

COUNTY OF TRAVIS      ™

The undersigned executive officer, general partner or proprietor of:

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Contractor to the Austin Independent School District for the following-described Work of construction, alteration or repair:

upon his oath does state:

All bills and claims for labor, material, equipment and otherwise for the above Work have been paid or otherwise satisfied, except as follows:

The undersigned makes this statement with the intent that it be believed and that, in reliance hereon, AISD will make final payment for the above Work.

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SUBSCRIBED AND SWORN TO BEFORE ME, the undersigned authority, this

\_\_\_\_\_ day of \_\_\_\_\_, 20 . \_\_\_\_\_

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Notary Public State of Texas

**AISD PROJECT NO.**

**CONTRACTOR CERTIFICATION**

I, the undersigned authorized signatory for \_\_\_\_\_ (“Contractor”), certify to Austin Independent School District (“Owner”) that:

1. The List of Covered Employees dated as of \_\_\_\_\_, 20\_\_ attached to this Certification (“List of Covered Employees”) includes (i) the names of all covered employees on the Project grouped by employer, and (ii) all information for each covered employee required by Section 3.15 of the General Conditions. All information on the List of Covered Employees is true and correct in all respects. An electronic copy in PDF format of the List of Covered Employees has also been delivered in accordance with the General Conditions.

2. Contractor has obtained (with respect to its covered employees) and has caused to be obtained (with respect to all other covered employees on the Project) all required criminal history record information relating to each covered employee on the List of Covered Employees in accordance with Texas Education Code (“TEC”) §22.0834.

3. Attached to this Contractor Certification is a duly completed and executed First Tier Subcontractor Certification in the form provided by Owner from each First Tier Subcontractor on the Project.

4. Each Sub-subcontractor on the Project has provided a Sub-subcontractor Certification to the appropriate First Tier Subcontractor in the form provided by Owner in accordance with the General Conditions.

5. None of the covered employees on the List of Covered Employees has a disqualifying criminal history under Section 3.15 of the General Conditions.

Capitalized terms used but not otherwise defined herein shall have the same meanings as designated in the Owner’s General Conditions of the Contract for Construction in connection with the Project (“General Conditions”). This Contractor Certification is delivered to Owner pursuant to Section 3.15 of the General Conditions and TEC §22.0834.

\_\_\_\_\_  
Date

\_\_\_\_\_  
*Signature of Authorized Signatory for Contractor*

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

Title: \_\_\_\_\_

**ATTACHMENT #1**

**AISD PROJECT NO.**

**LIST OF COVERED EMPLOYEES**

**[See Attached]**

**For \_\_\_\_\_**  
**(Contractor's Name)**

**ATTACHMENT #2**

**AISD PROJECT NO.**

**FIRST TIER SUBCONTRACTOR CERTIFICATIONS**

**[See Attached]**

**For the following First Tier Subcontractors:**

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**AISD PROJECT NO.**

**FIRST TIER SUBCONTRACTOR CERTIFICATION**

I, the undersigned authorized signatory for \_\_\_\_\_ (“First Tier Subcontractor”), certify to \_\_\_\_\_ (“Contractor”) and Austin Independent School District (“Owner”) that:

1. First Tier Subcontractor has entered into a contract with Contractor to provide services in connection with the Project.

2. All covered employees employed by First Tier Subcontractor on the Project are included on the List of Covered Employees furnished to Owner by Contractor dated as of \_\_\_\_\_, 20\_\_ (“List of Covered Employees”) and properly identified as employees of First Tier Subcontractor. The portion of the List of Covered Employees listing First Tier Subcontractor’s covered employees is attached hereto.

3. All information on the List of Covered Employees with regard to the employees of First Tier Subcontractor is true and correct in all respects.

4. First Tier Subcontractor has obtained all required criminal history record information relating to each covered employee of First Tier Subcontractor on the List of Covered Employees in accordance with Texas Education Code (“TEC”) §22.0834.

5. None of the covered employees on the List of Covered Employees employed by First Tier Subcontractor has a disqualifying criminal history under Section 3.15 of the General Conditions.

6. If applicable, attached to this First Tier Subcontractor Certification is a duly completed and executed Sub-subcontractor Certification in the form provided by Owner obtained by First Tier Subcontractor from each subcontractor employed on the Project by or under First Tier Subcontractor as required by the General Conditions.

Capitalized terms used but not otherwise defined herein shall have the same meanings as designated in the Owner’s General Conditions of the Contract for Construction in connection with the Project (“General Conditions”). This First Tier Subcontractor Certification is delivered to Owner and Contractor pursuant to Section 3.15 of the General Conditions and TEC §22.0834.

\_\_\_\_\_  
Date

\_\_\_\_\_  
*Signature of Authorized Signatory for First Tier Subcontractor*

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

Title: \_\_\_\_\_

**ATTACHMENT #1**

**AISD PROJECT NO.**

**APPLICABLE PORTION OF LIST OF COVERED EMPLOYEES**

**[See Attached]**

**For \_\_\_\_\_**  
**(First Tier Subcontractor's Name)**



**ATTACHMENT #2**

**AISD PROJECT NO.**

**SUB-SUBCONTRACTOR CERTIFICATIONS**

**[See Attached]**

**For the following Sub-subcontractors:**

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AISD PROJECT NO.

## **SUB-SUBCONTRACTOR CERTIFICATION**

I, the undersigned authorized signatory for \_\_\_\_\_ (“Sub-subcontractor”), certify to \_\_\_\_\_ (“First Tier Subcontractor”), \_\_\_\_\_ (“Contractor”) and Austin Independent School District (“Owner”) that:

1. Sub-subcontractor has entered into a contract with \_\_\_\_\_ to provide services in connection with the Project.
2. All covered employees employed by Sub-subcontractor on the Project are included on the List of Covered Employees furnished to Owner by Contractor dated as of \_\_\_\_\_, 20\_\_ (“List of Covered Employees”) and properly identified as employees of Sub-subcontractor. The portion of the List of Covered Employees listing Sub-subcontractor’s covered employees is attached hereto.
3. All information on the List of Covered Employees with regard to the employees of Sub-subcontractor is true and correct in all respects.
4. Sub-subcontractor has obtained all required criminal history record information relating to each covered employee of Sub-subcontractor on the List of Covered Employees in accordance with Texas Education Code (“TEC”) §22.0834.
5. None of the covered employees on the List of Covered Employees employed by Sub-subcontractor has a disqualifying criminal history under Section 3.15 of the General Conditions.
6. If applicable, attached to this Sub-subcontractor Certification is a duly completed and executed Sub-subcontractor Certification in the form provided by Owner obtained by Sub-subcontractor from each subcontractor employed on the Project by or under Sub-subcontractor as required by the General Conditions.

Capitalized terms used but not otherwise defined herein shall have the same meanings as designated in the Owner’s General Conditions of the Contract for Construction in connection with the Project (“General Conditions”). This Sub-subcontractor Certification is delivered pursuant to Section 3.15 of the General Conditions and TEC §22.0834.

\_\_\_\_\_  
Date

\_\_\_\_\_  
*Signature of Authorized Signatory for Sub-subcontractor*

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

Title: \_\_\_\_\_

**ATTACHMENT #1**

**AISD PROJECT NO.**

**APPLICABLE PORTION OF LIST OF COVERED EMPLOYEES**

**[See Attached]**

**For \_\_\_\_\_**  
**(Sub-subcontractor's Name)**

**ATTACHMENT #2**

**AISD PROJECT NO.**

**SUB-SUBCONTRACTOR CERTIFICATIONS**

**[See Attached]**

**For the following Sub-subcontractors:**

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# INDOOR AIR QUALITY MANAGEMENT

## SECTION 01 35 46

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Protection of heating, ventilating, and air conditioning systems.
2. Reducing emissions through source control.
3. Pathway interruption.
4. Housekeeping.
5. Scheduling.
6. Indoor Air Quality Management Plan.

B. Related Sections:

1. **01 81 13 Sustainable Construction Requirements**

#### 1.2 REFERENCES

- A. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- B. Sheet Metal and Air Conditioning Manufacturer's Association International (SMACNA) - IAQ Guidelines for Occupied Buildings Under Construction.

#### 1.3 SUBMITTALS

A. Indoor Air Quality Management Plan:

1. Submit Indoor Air Quality Management Plan for review within ten days after date of Notice to Proceed. Plan should address key issues for IAQ protections such as scheduling, source control, HVAC protection pathway interruption, and housekeeping. Include:
  - a. Procedures for implementing requirements of SMACNA IAQ Guideline.

- b. Substitution procedures for products that are responsibility of Contractor and proposed source control implementation measures to minimize building contamination.
  - c. Construction sequencing and storage plans for protection of stored on-site or installed absorptive materials against moisture absorption and contamination.
  - d. Filter media change schedule. Minimum MERV filtration media per Section 3.1
  - e. Contact Information including name, phone number, and email address of Contractor's personnel responsible for instructing workers and overseeing and documenting results of Indoor Air Quality Management Plan.
2. If required, revise and resubmit plan within ten days after receipt of comments.
  3. Distribute copies of approved Indoor Air Quality Management Plan to concerned parties.
- B. Photographs: Document indoor air quality management measures including protection of ducts, on-site storage, and protection of installed absorptive materials. Provide date stamped photographs for at least three separate site visits.

#### 1.4 QUALITY ASSURANCE

- A. Review and discuss Indoor Air Quality Management Plan implementation and progress at Preconstruction Conference and Progress Meetings.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Designate specific storage areas to facilitate protection of stored absorptive materials.
- B. Clearly identify storage area. Keep clean and orderly; prevent contamination of materials.
- C. Monitor storage areas for contamination; correct problems and implement preventative measures.
- D. Store materials off ground on pallets or skids. Keep materials covered and protected until ready for installation.

## 1.6 TRAINING

- A. Provide training of indoor air quality management methods to be used at appropriate stages of Project.
- B. Include Indoor Air Quality plan and implementation as an agenda item to Pre-Construction meeting as well as Pre-Installation meetings.
- C. Require participation of all subcontractors and include as agenda item to subcontractor meetings.

## PART 2 - PRODUCTS

Not Used

## PART 3 - EXECUTION

### 3.1 IMPLEMENTATION

- A. During construction, meet or exceed SMACNA minimum requirements for heating, ventilating, and air conditioning system protection, source control, pathway interruption, housekeeping, and scheduling.
- B. Protect stored on-site or installed absorptive materials from moisture damage and volatile organic compound contamination through construction sequencing and proper storage.
- C. If air handlers are used during construction, use filtration media with minimum MERV of 8.
- D. Replace filtration media MERV of 13 just prior to occupancy.  
Provide photos documenting filtration change prior to occupancy.
- E. Heating, Ventilating, and Air Conditioning System Protection:
  - 1. Keep duct systems including supply air, return air, and exhaust air and associated equipment including air handlers, variable air volume boxes, silencers, fans, and filter boxes, clean and uncontaminated.
  - 2. Seal taps and open ends not actively being worked on with plastic and tape.
  - 3. Provide 1 inch polyester filter media over return and exhaust air inlets during construction and until Substantial Completion.
  - 4. Ensure that temporary and permanent filters are in place at openings

before running fans.

F. Source Control:

1. For temporary and ancillary materials used in construction, follow requirements of similar products in Divisions 2 through 49 to minimize indoor air quality impacts.
2. Use nontoxic formulations and implement other control measures to minimize building contamination.

G. Pathway Interruption: Isolate areas where work is being performed to prevent contamination of clean spaces.

H. Housekeeping:

1. Implement cleaning activities concentrating on heating, ventilating, and air conditioning systems and building space to remove contaminants prior to occupancy.
2. Protect materials from weather and store in clean area prior to unpacking.
3. Clean coils, air filters, and fans before performing testing and balancing.

I. Scheduling:

1. Sequence construction activities to reduce absorption of and volatile organic compounds by materials.
2. Complete applications of wet and odorous materials before installing absorptive materials.

### 3.2 DOCUMENTATION

A. Prepare and submit documentation as required to meet the requirements of the Sustainability Rating System chosen for the project:

1. Austin ISD Sustainability Scorecard.
2. Austin Energy Green Building.
3. LEED.

END OF SECTION 013546



## **FINAL CLEANING**

### SECTION 017400

#### PART 1 GENERAL

##### 1.1 REQUIREMENTS INCLUDED

- A. Final cleaning of project.

##### 1.2 RELATED REQUIREMENTS

- A. Document – General Conditions: Cleaning up.
- B. Section 017700 – Contract closeout: Closeout procedures.
- C. Section 017419- Construction Waste Management

##### 1.3 DESCRIPTION

- A. Execute cleaning prior to inspection for substantial completion of each designated portion of the work.

#### PART 2 PRODUCTS

##### 2.1 CLEANING MATERIALS

- A. Use materials which will not create hazards to health or property, and which will not damage surfaces.
- B. Use only materials and methods recommended by manufacturer of material being cleaned.
- C. Refer to AISD's Green Cleaning Program for least hazardous materials and methods.

#### PART 3 EXECUTION

##### 3.1 CLEANING

- A. In addition to removal of debris and cleaning specified in other sections, clean interior and exterior exposed-to-view surfaces.
- B. Remove temporary protection and labels not required to remain.

# CONSTRUCTION WASTE MANAGEMENT

## SECTION 01 74 19

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Construction waste management goals, plan, and records.

B. **Related Sections:**

1. **01 81 13 Sustainable Construction Requirements**

#### 1.2 REFERENCES

- A. Austin Resource Recovery, Zero Waste Master Plan Ordinance. 20100930-023

<http://www.austintexas.gov/department/services-business>

#### 1.3 WASTE MANAGEMENT REQUIREMENTS

- A. Reuse, salvage, or recycle non-hazardous waste materials.

- B. Maximize diversion of construction debris from landfill.

- C. Prioritize non-hazardous construction waste management in following order:

1. Reduce amount of waste generated.
2. Reuse materials through on-site reuse or off-site salvaging, including sale or donation.
3. Recycle materials including diverting materials for secondary uses whenever economically feasible.
4. Dispose of materials with no practical use or economic benefit at permitted landfill.

- D. Divert minimum **75** percent of non-hazardous construction waste by weight (in tons) from landfills through reuse, recycling and composting. Landclearing debris and excavated soil and rocks do not contribute to the calculation.

## 1.4 CONSTRUCTION WASTE MANAGEMENT

- A. Take proactive role in management of construction and demolition waste:
1. Practice efficient waste management when sizing, cutting, and installing products.
  2. Facilitate reuse and recycling and utilize all reasonable means to divert construction and demolition waste from landfills.
  3. Return unused products and overages to supplier, or donate to non-profit group.
  4. Carefully install products; avoid removal of ill-timed and poorly installed products.
  5. Use centralized cutting areas to facilitate waste collection.
  6. Deliver, store, and handle products to prevent damage.
  7. Specify delivery of product and materials with minimum packaging; all packaging specified as reusable and returned to manufacture, or recyclable.
- B. Require subcontractors and suppliers to implement the Construction Waste Management Plan by prioritizing waste reduction, reuse, and recycling.
- C. Construction waste includes:
1. Products from demolition and removal.
  2. Excess and unusable construction products.
  3. Packaging materials for construction products.
  4. Other materials generated during construction process but not incorporated into the work.
- D. Give consideration to:
1. Availability of viable recycling markets.
  2. Condition of materials.

3. Ability to provide material in suitable condition and in quantities acceptable to available markets.
4. Time constraints imposed by internal project completion mandates.
- E. Be responsible for implementation of special programs involving rebates and similar incentives related to recycling of waste.
- F. Revenues and other savings obtained for salvage and recycling accrue to Contractor.
- G. Ensure that firms and facilities used for recycling, reuse, and disposal have legal permits for intended uses.

## 1.5 SUBMITTALS

- A. Construction Waste Management Plan:
  1. Submit Construction Waste Management Plan within ten days after Notice to Proceed and prior to initiating site preparation.
  2. Include:
    - a. Name and contact information of individual on Contractor's staff responsible for waste prevention and management.
    - b. Actions proposed to reduce solid waste generation and achieve waste diversion goal.
    - c. Description of proposed methods for recycling and reuse of materials generated, including areas and equipment for processing, sorting, and temporary storage.
    - d. Estimated types and quantities, in tons, of waste to be generated.
    - e. Name of landfills to be used.
    - f. Identification of local and regional reuse programs that will accept waste materials.
    - g. List of waste materials to be salvaged for resale, salvaged and reused, or recycled. Identify recycling facilities to be used.
    - h. Identification of materials that cannot be recycled or reused, with justification.

3. If required, revise and resubmit Construction Waste Management Plan within ten days after receipt of comments.
4. Distribute copies of approved Construction Waste Management Plan. Update Construction Waste Management Plan periodically through duration of Project to reflect changed conditions.

B. Construction Waste Management Documents:

1. Maintain records to document:
  - a. Quantities of waste generated, in tons.
  - b. Quantities of waste diverted through sale, reuse, or recycling, in tons, and diversion location.
  - c. Quantities of waste sent to landfill in tons
2. Submit monthly summary of waste disposal and diversion to date in conjunction with each request for payment.
3. Submit manifests, weight tickets, receipts, or invoices, identifying Project and waste material(s), upon request.
4. Deliver final summary of solid waste disposal and diversion to Architect upon completion of project.
5. Use the following solid waste conversion factors when weight tickets are not available:

<b>Asphalt</b>	<b>1,380 lbs/CY</b>
<b>Wood Pallets</b>	<b>300 lbs/CY</b>
<b>Concrete</b>	<b>1,400 lbs/CY</b>
<b>Concrete Washout</b>	<b>1,400 lbs/CY</b>
<b>Clean Wood</b>	<b>300 lbs/CY</b>
<b>Miscellaneous Wood Scraps</b>	<b>300 lbs/CY</b>
<b>Wood Chips</b>	<b>500 lbs/CY</b>
<b>Steel</b>	<b>1,000 lbs/CY</b>
<b>Miscellaneous Metals</b>	<b>100 lbs/CY</b>
<b>Gypsum Wallboard/Sheetrock</b>	<b>500 lbs/CY</b>
<b>Plastics/Plastic Bottles</b>	<b>76 lbs/CY</b>
<b>Cardboard</b>	<b>100 lbs/CY</b>
<b>Glass Bottles</b>	<b>600lbs/CY</b>
<b>Aluminum Cans</b>	<b>175 lbs/CY</b>
<b>Miscellaneous Waste</b>	<b>350 lbs/CY</b>
<b>Job Trailer Paper</b>	<b>150 lbs/CY</b>

## 1.6 QUALITY ASSURANCE

- A. Review and discuss Construction Waste Management Plan implementation and progress at Preconstruction Conference and Progress Meetings.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. Designate separate areas to facilitate separation of materials for potential recycling, salvage, reuse and return.
- B. Clearly identify areas and receptacles with signage clearly written in both English and Spanish.
- C. Keep storage areas and receptacles clean and orderly; prevent contamination of materials.
- D. Monitor storage areas; correct problems and implement preventative measures.

## 1.8 TRAINING

- A. Provide training of construction waste management methods to be used at appropriate stages of Project.
- B. Include Construction Waste Management as an agenda item for Pre-Construction meeting, at each Pre-Installation meeting, and at weekly site meetings.
- B. Require participation of all subcontractors.

## PART 2 – PRODUCTS

Not Used

## PART 3 – EXECUTION

### 3.1 WASTE COLLECTION

- A. Provide containers and storage areas to facilitate construction waste management, clearly identified. Provide signage written in both English and Spanish.
- B. Handle recyclable materials to prevent contamination by incompatible products and materials.

- C. Separate materials by:
  - 1. Placing into marked separate containers, then transporting to recycling facility.
  - 2. Placing into single container, then transporting to recycling facility for separation.

### 3.2 DISPOSAL

- A. Dispose of nonhazardous waste materials that cannot be reused, recycled, or salvaged at permitted landfill.
- B. Handle, store, and dispose of hazardous wastes in accordance with applicable codes, ordinances, rules, and regulations.

### 3.3 DOCUMENTATION

- A. Prepare and submit documentation as required to meet the requirements of the Sustainability Rating System chosen for the project:
  - 1. Austin ISD Sustainability Scorecard.
  - 2. Austin Energy Green Building.
  - 3. LEED.

END OF SECTION 01 74 19

**SUSTAINABLE CONSTRUCTION REQUIREMENTS**

## SECTION 01 81 13

## PART 1 – GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Section includes general requirements and procedures for sustainable construction practices and documentation.
2. Renovation projects: section includes requirements for meeting the sustainability guidelines set forth in the customized Austin ISD Sustainability Scorecard.

## B. Related Sections:

1. General Conditions – Payment Procedures
2. Section 01 35 46 – Indoor Air Quality Management
3. Section 01 74 19 – Construction Waste Management
4. Section 01 91 13 – Commissioning Requirements
5. Divisions 1 through 49 Sections for sustainability requirements specific to the work of each of those sections.

## 1.2 REFERENCES

- A. Austin Energy Green Building (AEGB) Commercial Program – Source for AEGB commercial rating packet with materials calculators:  
<http://greenbuilding.austinenergy.com/wps/wcm/connect>
- B. Austin ISD Sustainability Scorecard for projects with limited scope that are not suited for AEGB or LEED and are not whole building or major renovation projects.
- C. LEED for Schools – Rating system specifically designed for new school construction and major renovations. LEED 2009 for Schools:  
<http://www.usgbc.org/Docs/Archive/General/Docs5547.pdf>; LEED v4 BD+C including LEED for Schools: <http://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version>
- D. City of Austin Code – Subchapter E of Chapter 25-2: Design Standards and Mixed Use, Article 2.5 Exterior Lighting:  
<http://www.austintexas.gov/edims/document.cfm?id=191794>



- E. Green Seal Standard GS-11 - VOC thresholds including for paints, primers and anti-corrosive coatings: [www.greenseal.org](http://www.greenseal.org)
- F. South Coast Air Quality Management District (SCAQMD) Rule 1113 – VOC limits for architectural coatings, as per most recent amendment:  
<http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1113.pdf>
- G. South Coast Air Quality Management District (SCAQMD) Rule 1168 – VOC limits for adhesives, sealants and sealant primers, as per most recent amendment: <http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1168.pdf?sfvrsn=4>
- H. GREENGUARD – Product certification for low emitting interior building materials, furnishings, and finish systems: <http://greenguard.org/en/index.aspx>
- I. GREENGUARD Gold – Product certification for low emitting interior building materials, furnishings, and finish systems:  
[http://greenguard.org/en/CertificationPrograms/CertificationPrograms\\_ChildrenSchools.aspx](http://greenguard.org/en/CertificationPrograms/CertificationPrograms_ChildrenSchools.aspx)
- J. Carpet and Rug Institute – Green Label Plus testing program for low VOC carpet; Green Label Cushion certification for low VOC carpet cushion:  
[www.carpet-rug.com](http://www.carpet-rug.com)
- K. Forest Stewardship Council – FSC product certification for wood and wood products: <https://us.fsc.org/>
- L. Resilient Floor Covering Institute – FloorScore® IAQ Certification for flooring products: [www.rfci.com](http://www.rfci.com)
- M. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2<sup>nd</sup> edition, Chapter 3 - Indoor air quality measures during construction:  
[www.smacna.org](http://www.smacna.org)
- N. Scientific Certification Systems Global Services – Indoor Advantage Gold certification for furniture, finishes and interior building materials –  
[www.scsglobalservices.com](http://www.scsglobalservices.com)
- O. Collaborative for High Performance Schools – CHPS National Core Criteria for school design and operations: [www.chps.net](http://www.chps.net)

### 1.3 SUSTAINABLE CONSTRUCTION REQUIREMENTS

- A. Adhere to requirements established by AISD and developed for project to advance sustainability and green building objectives.

- B. Renovation projects: adhere to requirements to achieve the goals and guidelines as set forth in the customized AISD Sustainability Scorecard, Austin Energy Green Building and/or LEED for Schools, as applicable to each project.
- C. Obtain Architect's approval of substitution, change, or alteration of sustainable materials and systems and installation procedures prior to incorporation into Project.
- D. Assist Architect in providing project sustainability documentation.
- E. Provide any submittals required to document conformity to AISD Sustainability Scorecard criteria on a scheduled basis as requested by Architect. For each submitted material and product requiring sustainability documentation, provide filled out AISD Sustainability Submittal Sheet.

#### 1.4 SUBMITTALS

- A. For all projects, provide the following:
  - 1. Management Plans:
    - a. Indoor Air Quality Management Plan: Complying with Division 1 Section 01 35 46 "Indoor Air Quality Management".
    - b. Construction Waste Management Plan: Complying with Division 1 Section 01 74 19 "Construction Waste Management".
  - 2. Progress Reports:
    - a. Indoor Air Quality Management Reports: Verifying compliance with Division 1 Section 01 35 46 "Indoor Air Quality Management".
    - b. Construction Waste Management Reports: Monthly progress reports verifying diversion of waste from the landfill to comply with Division 1, Section 01 74 19 "Construction Waste Management".
  - 3. Sustainable Design Documentation Submittals:
    - a. Refer to Appendix A for required submittal documentation to verify compliance with sustainability goals.
    - b. Refer to Appendix B for sustainability coversheet for subcontractors to complete.
- B. For Renovation projects meeting the guidelines set forth in the customized AISD Sustainability Scorecard, provide the following additional requirements:

1. Project Materials Cost Data Submittals: Submit documentation necessary for calculating Materials and Products points for the customized AISD Scorecard:
  - a. Submit a Statement of Total Project Costs.
  - b. Schedule of Values: Submit a schedule of materials costs, labor and equipment excluded, for Divisions 3-10, 31) Section 31.60.00 Foundations) and 32 (Sections 32.10.00 Paving, 32.30.00 Site Improvements, and 32.90.00 Planting).
  - c. Materials and Products Cost Documentation: Submit documentation for each material and product submitted as follows:
    - i. Material Description:
      - i) Identify materials by specification section number.
      - ii) Provide separate line item for each material submitted.
    - ii. Cost data: Include materials cost data, excluding labor and equipment, for each line item submitted.
2. AISD Sustainability Scorecard Calculators: Submit completed materials calculators for submitted products and materials used on Project as follows:
  - a. Building Materials Calculator (Recycled Content and Regional Source)
  - b. Certified Wood Calculator (as certified by Forest Stewardship Council)
3. Basic Requirement Documentation: Provide the following required documentation to verify compliance with AISD Sustainability Scorecard Minimum Requirements:
  - a. Building Systems Commissioning – Mechanical, Electrical, Plumbing: Comply with Division 1 Section 019113 “Commissioning Requirements” and prepare Basis of Design.
  - b. Building Water Use Reduction: Submit cut sheets for all faucets, showerheads, toilets and urinals indicating flow rates (gallons/minute) and flush volumes (gallons/flush).
  - c. Low VOC Interior Adhesives and Sealants, Paints and Coatings: Submit product data and/or Material Safety Data Sheets (MSDS) for all adhesives and sealants, paints and coatings used inside the building’s moisture barrier indicating the VOC content of each product and verifying that each product meets the requirements of Green Seal GS-11, SCAQMD Rule 1113, and SCAQMD Rule 1168 as relevant.

- d. Construction Waste Management: Comply with Division 1 Section 01 74 19 "Construction Waste Management" and document a minimum of 75% diversion of waste by weight.
- e. Indoor Air Quality Management: Comply with Division 1 Section 01 35 46 "Indoor Air Quality Management" and document implementation of IAQ Management Plan.
- f. Energy Efficiency-Mechanical: Submit documentation verifying HVAC equipment with minimum 10% more efficient than ASHRAE 90.1-2010 minimum efficiency requirements.
- g. Energy Efficiency-Interior Lighting: Submit documentation verifying lighting equipment 15% more efficient (watts per square foot) than maximum allowed by ASHRAE 90.1-2010.
- h. Energy Efficiency-Envelope: Submit documentation verifying building envelope complies with Part 5, ASHRAE 90.1-2010.
- i. Storage + Collection of Recyclables + Compostables: Submit drawings identifying area for collection of recyclables and compostable materials in all new and/or renovated spaces.
- j. Acoustical Performance-Design: Submit drawings illustrating acoustical separation of learning spaces from noise generating spaces.
- k. Acoustical Performance-Ceilings: Submit documentation verifying ceiling tiles comply with NRC of 0.70 or better.
- l. Acoustical Performance-STC Ratings: Submit documentation verifying learning spaces comply with ANSI S12-2010 and ASHRAE Handbook 2011, Chapter 48.
- m. Native and Non-Invasive Adapted Species: Submit documentation verifying all plants are native or non-invasive adapted species.
- n. Outdoor Water Use Reduction: Submit AISD Water Use Calculator verifying minimum 30% reduction in outdoor water use.
- o. Integrated Pest Management: Submit Integrated Pest Management Plan verifying compliance with AISD Integrated Pest Management Policy.

## 1.5 QUALITY ASSURANCE

- A. Designate personnel on Contractor's staff responsible for instructing workers and overseeing and documenting results of sustainable design requirements for Project. Provide contact name and information.
- B. Require compliance with sustainable design requirements by subcontractors and suppliers.

- C. Include sustainability goals as agenda items for Pre-Construction conference, Pre-Installation meeting and weekly subcontractor meetings.

## 1.6 DEFINITIONS

- A. Regionally Sourced Material: Materials that are sourced/harvested and manufactured within a 500-mile radius of the project site. Manufacturing refers to the final assembly of components into the building product that is installed at the Project site.
- B. Recycled Content – The percentage of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
  - 1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
  - 2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.
- C. Agrifiber – Product manufactured from agricultural-based fiber.
- D. Material Safety Data Sheet (MSDS) – Sheet contains information about occupational exposure to hazardous chemicals and risks, and recommended procedures for treating exposure. MSDS' are federally required to be in workplaces where chemicals are present that meet Occupational Safety and Health Administration's (OSHA) definition of "hazardous" and are used to verify chemical composition, including VOCs, of construction materials and products.
- E. Volatile Organic Compound (VOC) – as defined by the US EPA. A chemical compound or mixture, derived from a vegetable or animal source (including certain minerals such as coal or petroleum that originally came from vegetable or animal sources), contained in a solid or liquid that volatilizes or evaporates at room temperature or an elevated temperature and, therefore, becomes present in the air or in discharge as vapor or smoke.
- F. FSC – Forest Stewardship Council
- G. Chain-of-Custody – A document that tracks movement of wood from the forest to a vendor and is used to verify compliance with FSC guidelines.

PART 2 – PRODUCTS

2.1 LOW-EMITTING MATERIALS STANDARDS

A. Adhesives and Sealants

1. VOC limits in grams per liter for adhesives and sealants are as follows:

	Maximum VOC Level
<b>Welding and Installation</b>	
Indoor Carpet Adhesives	50
Carpet Pad Adhesives	50
Wood Flooring Adhesive	100
Rubber Floor Adhesives	60
Subfloor Adhesives	50
Ceramic Tile Adhesives	65
VCT and Asphalt Tile Adhesives	50
Dry Wall and Panel Adhesives	50
Cove Base Adhesives	50
Multipurpose Construction Adhesives	70
Structural Glazing Adhesives	100
Single Ply Roof Membrane Adhesives	250
PVC Pipe Welding (Adhesive)	510
CPVC Welding	490
ABS Welding	325
Plastic Cement Welding	250
Adhesive Primer for Plastic	550
Contact Adhesive	80
Special Purpose Contact Adhesive	250
Adhesive Primer for Traffic Marking	150
Structural Wood Member Adhesive	140
<b>Substrate Specific Applications</b>	
Metal to metal	30
Plastic Foams	50
Porous Material (except wood)	50
Wood	30
Fiberglass	80
<b>Sealants</b>	
Architectural	250
Marine Deck	760
Nonmembrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420
<b>Sealant Primers</b>	
Architectural- Nonporous	250
Architectural- Porous	775
Modified Bituminous	500

Marine Deck	760
Other	750

## B. Paints and Coatings

- VOC Limits in grams per liter for paints, primers and anti-corrosive coatings are as follows:

<b>Coatings</b>	<b>Maximum VOC Level (g/L)</b>
Flat Topcoat	50
Non-flat Topcoat	100
Primer	100
Anti-Corrosive Coating	250

- VOC limits in grams per liter for clear wood finishes, coatings, stains, sealers and shellacs are as follows:

	<b>Maximum VOC Level (g/L)</b>
<b>Clear Wood Finish</b>	
Varnish	275
Sanding Sealers	275
Lacquer	275
<b>Concrete-Curing Compounds</b>	100
<b>Dry-Fog coatings</b>	150
<b>Floor Coatings</b>	50
<b>Industrial Maintenance Coatings</b>	100
<b>Primers, Sealers and Undercoaters</b>	100
<b>Quick-Dry Enamels</b>	50
<b>Quick-Dry Primers, Sealers, and Undercoaters</b>	100
<b>Roof Coatings</b>	50
Roof Coatings, Aluminum	100
<b>Roof Primers, Bituminous</b>	350
<b>Shellac</b>	
Clear	730
Pigmented	550
<b>Stains, Interior</b>	100
<b>Traffic Coatings</b>	100
<b>Waterproofing sealers</b>	100
<b>Wood Preservatives</b>	350

PART 3 – EXECUTION

3.1 INDOOR AIR QUALITY MANAGEMENT

- A. Indoor Air Quality Management – Comply with Division 1 Section 01 35 46  
“Indoor Air Quality Management.”

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Construction Waste Management - Comply with Division 1 Section 01 74 19  
“Construction Waste Management.”

3.3 COMMISSIONING

- A. Commissioning (Mechanical, Electrical, Plumbing) – Comply with Division  
1 Section 01 91 13



# APPENDIX A Sustainability Scorecard

Note to Specifier: Replace AISD Sustainability Scorecard with Austin Energy Green Building or LEED Credit checklist depending on rating system chosen

AUSTIN ISD SUSTAINABILITY SCORECARD		Project Number - School	
Y	N	Mandatory Requirements	Voluntary Requirements
		ALL.1M Basis of Design Document: AE to prepare narrative at SD and update	ALL.1V Optimize Energy Performance: 6% improvement over baseline
		ALL.2M Design Review Process: Sustainability Review at SD, DD, CD	ALL.2V Construction Waste Management: 95% diversion from landfill
		ALL.3Ma Low Emitting Materials - Adhesives, Sealants, Paints + Coatings: Low VOC	ALL.3V Sustainably Sourced Materials and Products: 20% of construction cost to be regionally sourced, contain recycled School As a Teaching Tool: Educate building occupants w/ signage, case study published on district website, digital Enhanced Refrigerant Management: No refrigerants
		ALL.3Mb Low Emitting Materials - Composite wood and agrifiber: No added formaldehyde	M3V Controlability of Systems - Thermal Comfort: Occupant Indoor Chemical and Pollutant Control: Walk-off mats, separate ventilation, MERV13 filters
		ALL.3Mc Low Emitting Materials - Flooring: Green Label Plus, Low Emitting Materials - Insulation (batt): No added formaldehyde	E1V Renewable Energy: Offset 1 to 10% of building energy cost
		ALL.3Md Low Emitting Materials - Wall and Ceiling Systems: Must be SCS Indoor Advantage Gold or GreenGuard Gold Certified	E2V Controlability of Lighting Systems: Occupant controls
		ALL.3Me Low Emitting Materials - Insulation (batt): No added formaldehyde	E3V Daylight Controls: Sensors
		ALL.4M Construction Waste Management: Divert 75% from landfill	P1V Indoor Water Use Reduction: Use 10% less water than CoA
		ALL.5M IAQ During Construction: Provide IAQ plan	P2V Process Water Reduction: Comply w/ AISD process water
		M1M Energy Efficiency - Mechanical: Renovation: 10% > ASHRAE	ARCH11V Envelope Commissioning - Additions & Major Renovations: Cx of envelope to comply with NIBS 3-2012
		M2M Commissioning - Mechanical: Reference AISD standard spec	ARCH12V Views to Outside: Provide 75% of occupied spaces with views
		E1M Energy Efficiency - Lighting: 15 > ASHRAE 90.1-2010	ARCH13V Daylighting: Provide 70% of occupied spaces with daylighting
		E2M Commissioning - Electrical: Reference AISD standard spec	ARCH14V Low Emitting Materials - Furniture and Furnishings: Meet CA 01.350 as verified by GREENGUARD Gold Standard or SCS
		P1M Indoor Water Use Reduction: Use 5% less water than CoA	ARCH15V Moisture Protection: Install no vinyl or plastic laminate wall coverings or other fiber reinforced plastic or vinyl as the finish
		P2M Commissioning - Plumbing: Reference AISD standard spec	ARCH16V Low Emitting Materials - Insulation (non-batt): no added
		ARCH.1M Storage & Collection of Recyclables & Compostables	ARCH17V Construction IAQ Mgmt Before Occupancy, Air Testing: Conduct IAQ testing according to AISD IAQ Testing Standards
		ARCH.2M Energy Efficiency - Envelope: Part 5 of ASHRAE 90.1-2010	SITE.1V Construction IAQ Mgmt Before Occupancy, Flush Out: Install new filters and supply 14,000 cu.ft. of outdoor air per SF
		ARCH.3M Acoustical Performance-1: ASHRAE handbook Chpt 48	SITE.2V Protect and Restore Habitat: Restore 30% or more
		ARCH.4M Acoustical Performance-2: Ceiling Tiles w/ NRC of 0.70 or better	SITE.3V Maximize the Open Space: Provide open space equal to 30% of Stormwater Design Quality: Manage a volume of stormwater equal to 50% of water quality volume (WQV) by infiltration on site
		ARCH.5M Acoustical Performance-3: Isolate learning spaces in compliance with ANSI S12-2010	SITE.4V Site Assessment: Design narrative
		SITE.1M Native and Non-Invasive Adapted Species	SITE.5V Outdoor Water Use reduction: 50% reduction or no potable
		SITE.2M Outdoor Water Use Reduction - 30%: Document 30%	SITE.6V Parking Capacity: Reduce parking by min. of 20% above code
		SITE.3M Integrated Pest Management: Refer to AISD standard spec	SITE.7V Carpools, vanpools, LEV & FEV: Provide 5% preferred parking for car/van pools and low emitting fuel efficient vehicles.
			SITE.8V Reduce Heat Island Effect: Green roof for 25% or shading 50% hardscape or 50% hardscape with SRI >29
			SITE.9V Light Pollution Reduction: Meet requirements for uplighting
			SITE.10V Learning Environment: Outdoor classroom
<p><b>NOTE:</b> This score card is an appendix to 01 13 Sustainable Construction Requirements. Not all mandatory items are applicable to all project types. The AISD PM &amp; AE are to meet with the EWAS team to review the scorecard to determine project specific goals. This scorecard is a summary of the project specific goals defined by the design team and AISD.</p>			

**APPENDIX B  
Sustainability Submittal Sheet**

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!!

**Sustainability Submittal Sheet:** ! Date: \_\_\_\_\_!

Instructions: Submit a separate form for each material / product. Fill out all that applies. This information is used for Sustainability Calculations and documentation only. Add pages as necessary.

**A. General Information:**

Product Type: \_\_\_\_\_ CSI Number: \_\_\_\_\_  
 Contractor/Subcontractor: \_\_\_\_\_ Submittal Number: \_\_\_\_\_  
 Contact Name: \_\_\_\_\_ Contact Phone Number: \_\_\_\_\_  
 Product Name: \_\_\_\_\_ Manufacturer: \_\_\_\_\_

! **B. Material Cost (Excluding Labor and Equipment):** \$ \_\_\_\_\_

**C. Local / Regional Materials:**

Location of Extraction (City/State): \_\_\_\_\_ Location of Manufacture (City/State): \_\_\_\_\_  
 Distance from Project: \_\_\_\_\_ Distance from Project: \_\_\_\_\_

**D. Recycled Content:**

Post-Consumer Recycled Content %: \_\_\_\_\_ Pre-Consumer Recycled Content %: \_\_\_\_\_

! **E. FSC Wood (Attach documentation of Chain of Custody):**

Chain of Custody number (COC #): \_\_\_\_\_ FSC Certified Wood % (for assemblies): \_\_\_\_\_

! **F. Re-used / Salvaged / Refurbished:** Product is a Re-used / Salvaged / Refurbished Material?: !Yes!

! **G. Flooring (Attach Documentation of Certification/Standard):**

Specify Certification:  Green Label Plus (Carpets);  Green Label (Carpet Pad);  Floor Score (Resilient Flooring);  Other \_\_\_\_\_

**H. No Added Urea-Formaldehyde (Attach Documentation):**

Proof of No Added Urea-Formaldehyde?:  Yes  No Specify Material: !Insulation  Composite Wood Product

! **I. Plumbing Fixtures:** (Add pages as necessary)

Fixture Type	Manufacturer	Model	gpf or gpm

**J. Roofing:** (Add pages as necessary)

Product Name & Manufacturer	SRI (Per ASTM C1549)	Solar Reflectance	SF of roof type

**K. Paints, Coatings, Adhesives & Sealants (Reference Green Seal GS-11 and SCAQMD 1168 & 1113):**

(Add pages as necessary)

Product Name & Manufacturer	Type of Paint, Coating, Adhesive or Sealant	VOC Content (g/l)	VOC Limit (g/l)	Application Location & Surface Type

! ! !!!

**SECTION 230100 – COMMISSIONING OF MECHANICAL 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. Section includes commissioning process requirements for mechanical (HVAC&R) systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section 016500 – “GENERAL COMMISSIONING REQUIREMENTS” for general commissioning process requirements.
  - 2. Division 26 Section 260100 - “COMMISSIONING OF ELECTRICAL SYSTEMS”.

**1.3 DEFINITIONS**

- A. Commissioning Authority (CxA): Independent agent hired by Owner and not associated with General Contractor or its subcontractors, Architect or its sub-consultants, or Construction Administrator or its staff or consultants. Under Owner’s direction, and not General Contractor’s direction, CA will direct and coordinate day-to-day commissioning activities without assuming oversight responsibilities.
- B. Refer to section 016500- GENERAL COMMISSIONING REQUIREMENTS for additional definitions and assignment of responsibilities.

**1.4 REFERENCES**

- A. National Environmental Balancing Bureau (NEBB) - Procedural Standards for Building Systems Commissioning
- B. American Air Balance Council (AABC) - Commissioning Guideline
- C. SMCNA - HVAC Systems commissioning Manual

**1.5 CONTRACTOR'S RESPONSIBILITIES**

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Perform commissioning tests at the direction of the CxA.**
- C. Attend construction phase controls coordination meeting.
- D. Attend testing, adjusting, and balancing review and coordination meeting.
- E. Participate in mechanical systems, assemblies, equipment, and component maintenance orientation and inspection.
- F. Provide information requested by the CxA for final commissioning documentation.
- G. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- H. Complete project-specific pre-functional/construction checklists and commissioning process test procedures for actual mechanical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- I. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.
- J. Verify testing, adjusting, and balancing of Work are complete.
- K. Provide test data, inspection reports, and certificates in Systems Manual.

**1.6 COMMISSIONING DOCUMENTATION**

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - 3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for mechanical systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that mechanical systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.
  - 8. Verification of testing, adjusting, and balancing reports.

**1.7 SUBMITTALS**

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.

**PART 2 - PRODUCTS (Not Used)****PART 3 - EXECUTION****3.1 GENERAL**

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.

**3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. Contractor shall conduct Pre-functional Testing to document compliance with installation and pre-functional checklists prepared by Commissioning Authority for Division-23 items.
- B. Request verification of Pre-functional checklists by CxA prior to proceeding with system start-up and Functional Testing of systems.
- C. Refer to Section 016500 - GENERAL COMMISSIONING REQUIREMENTS for issues relating to pre-functional checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.

**3.3 SYSTEM START-UP & INSPECTIONS**

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies.
- B. Contractor is solely responsible for all tests and inspections required by the Authority Having Jurisdiction (AHJ). All test reports and certificates required by the AHJ shall be submitted prior to Functional Testing.
- C. Contractor shall provide no less than 48 hours notice prior to conducting tests specified in other sections of the specifications, including:

- 1. Duct pressure tests

CxA shall witness tests at his discretion. Test results shall be documented with respective Pre-functional/construction checklists

### **3.4 FUNCTIONAL TESTING PREPARATION**

- A. Certify that mechanical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that mechanical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, corrective work approved, and balance has been verified by CxA (see paragraph below).
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, and alarm conditions).
- E. Inspect and verify the position of each device and interlocks identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed.

### **3.5 TESTING AND BALANCING VERIFICATION**

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Upon completion of testing and balancing work, submit a copy of the report for CxA via Architect. CxA shall review report and issue comments via the Architect.
- C. Verification: The CxA will notify Contractor seven (7) days in advance of the date of field verification. Notice will not include data points to be verified. This verification must take place prior to Functional Testing of systems.
  - 1. Provide technicians, instrumentation, and tools to verify testing and balancing of mechanical systems at the direction of the CxA.
  - 2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### **3.6 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of mechanical testing shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each space served. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Contracting Officer and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The CxA may direct that set points be altered when simulating conditions is not practical.
- G. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- H. If tests cannot be completed because of a deficiency outside the scope of the mechanical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.7 GENERAL TESTING PROCEDURES FOR HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT**

- A. HVAC Instrumentation and Control System Testing: Contractor shall fully test operation of controls system prior to requesting Functional Testing of equipment and systems with CxA. Point-to-point check out sheets and as-built control diagrams shall be provided to CxA so he may develop testing procedures. Refer to Section 230926c BUILDING AUTOMATION SYSTEM COMMISSIONING REQUIREMENTS for commissioning of controls.
- B. Mechanical Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan for piping systems. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA.
- C. HVAC Equipment Testing: Provide technicians, instrumentation, tools, and equipment to test performance of all HVAC equipment as outlined below.

### **3.8 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED**

#### **A. General**

1. The following paragraphs outline the functional test procedures for the various Div. 23 items to be commissioned. Functional testing will take place only after pre-functional checklists have been completed, equipment has been started-up, TAB has been verified, and Contractor has certified that systems are ready for functional testing.
2. All systems controlled via the Building Automation System shall have all control points and sequences tested by Controls Contractor prior to requesting testing by Commissioning Authority. Refer to Section 230926c BUILDING AUTOMATION SYSTEM COMMISSIONING REQUIREMENTS for commissioning of controls.
3. Refer to Section 016500 - GENERAL COMMISSIONING REQUIREMENTS for specific systems to be tested.

#### **B. All Equipment:**

1. Verify nameplate information (serial numbers, model numbers, etc.); verify that equipment capacity is in accordance with requirements of construction documents.
2. Verify unit runs smoothly and quietly.
3. Verify operation of safeties.
4. Verify electrical wiring and grounding is correct.
5. Verify maintenance and NEC clearances are maintained.
6. Verify Pre-Functional Checklists have completed.

#### **C. Exhaust Fans and Outside Air Units**

1. Record outside air temperature during test.
2. Record programmed schedules and interlocks
3. Verify fans run smoothly and quietly.
4. Verify voltages and amperages are within tolerance.
5. Verify fan data in TA&B report versus design
6. Verify backdraft damper operation
7. Verify all alarms and safeties.
8. Verify all sequences.

#### **D. Testing Adjusting and Balancing (TAB).**

1. Review TAB report for accuracy and completeness.
2. Take random sample of air flow from supply air diffusers and compare to TAB report / design drawings.
3. Take pressure readings at inlets and outlets of hydronic pumps and compare to TAB report and pump curves.

#### **E. Direct Digital Controls (DDC) for HVAC –Refer to Section 230926c BUILDING AUTOMATION SYSTEM COMMISSIONING REQUIREMENTS.**

### **3.9 TRAINING**

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.



**3.10 O&M MANUALS**

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS and section 017800 CLOSEOUT SUBMITTALS.

**END OF SECTION**

## SECTION 23 0500

### 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. This Section includes the following:
  1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Mechanical sleeve seals.
  5. Sleeves.
  6. Escutcheons.
  7. Grout.
  8. Equipment installation requirements common to equipment sections.
  9. Painting and finishing.
  10. Concrete bases.
  11. Supports and anchorages.

##### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  1. CPVC: Chlorinated polyvinyl chloride plastic.
  2. PE: Polyethylene plastic.
  3. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### **1.4 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.

#### **1.5 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.7 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. 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 (3.2-mm) 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.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, 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 general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### **2.4 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epcos Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
  
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epcos Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
  
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
  
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
  
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.

- c. Metraflex Co.
  - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Plastic Carbon steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.6 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

## **2.7 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- C. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **2.8 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## **2.9 PAINTS, ADHESIVES AND SEALANTS**

- A. Use paints, adhesive and sealants that 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," including 2004 Addenda.

## **PART 3 - EXECUTION**

### **3.1 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements 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.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit easy valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications and manufacturers data for roughing-in requirements.

### **3.2 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.



- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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.
- E. Brazed Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

### **3.3 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with no interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.5 PAINTING**

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.6 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 6. Use 3000-psi, 28-day compressive-strength concrete and reinforcements.

### **3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

### **3.8 GROUTING**

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION**

## SECTION 23 0513

### 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Related Requirements:
  - 1. Section 01 8113 "Additional LEED Requirements that may further inform this Section".

##### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Motors shall be manufacturer's premium efficiency design for constant speed motors and manufacturer's high efficiency design for variable speed motors
- D. Service factor 1.15.
- E. Class F insulation or better with a Class B rise at a 1.0 service factor; multi-dipped and baked in Class H varnish.

- F. Stator windings copper. Motor leads stranded copper and are permanently identified and brought out to the terminal box through a neoprene gasket.

## **2.2 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor. Motors shall be capable of developing NEMA Design B locked rotor and pull up torque with 90% of rated voltage applied.
- C. Mechanical: stator frame and end brackets are a minimum of grade 25 cast iron construction; terminal box is one size larger than NEMA requirements and rotatable in 90-degree increments; external cooling fans are non-sparking corrosion resistant material; quantity of two drain holes at the lowest points of the motor frame; bearings L-10 life of 40,000hours or 100,000hours for direct-coupled loads; nameplate 304 stainless steel and fastened with four stainless steel ins; all hardware zinc-dichromate plated; balanced dynamically to 0.6 mils peak to peak maximum displacement; capable of all positioning mounting and operation.
- D. Insulation: Class F
- E. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- F. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- G. Testing per NEMA MG1-12.

## **2.3 POLYPHASE MOTORS**

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## **2.4 SINGLE-PHASE MOTORS**

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

**END OF SECTION**

## SECTION 23 0529

### 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. This Section includes the following:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Equipment supports.
- B. See Division 23 Section "Metal Ducts" for duct hangers and supports.
- C. Related Requirements:
  - 1. Section 01 8113 "Additional LEED Requirements that may further inform this Section".

##### 1.3 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## **1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
  - 3. Equipment supports.
- C. Welding certificates.

## **1.6 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.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: provide products by one of the manufacturers specified.

### **2.2 STEEL PIPE HANGERS AND SUPPORTS**

### **2.3 METAL PIPE HANGERS AND SUPPORTS**

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel
- B. Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. Empire Industries, Inc.
  - 3. Globe Pipe Hanger Products, Inc.
  - 4. Grinnell Corp.
  - 5. National Pipe Hanger Corporation.
  - 6. Piping Technology & Products, Inc.

## **2.4 METAL FRAMING SYSTEMS**

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper B-Line, Inc.
    - b. Thomas & Betts Corporation.
    - c. Unistrut Corporation; Tyco International, Ltd.
  - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with inturned lips.
  - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel
  - 7. Metallic Coating: galvanized

## **2.5 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

## **2.6 THERMAL-HANGER SHIELD INSERTS**

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. ERICO/Michigan Hanger Co.
  - 3. PHS Industries, Inc.
  - 4. Pipe Shields, Inc.
  - 5. Rilco Manufacturing Company, Inc.
  - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.



## **2.7 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head.
    - c. Masterset Fastening Systems, Inc.
    - d. MKT Fastening, LLC.
    - e. Powers Fasteners.
  
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.

## **2.8 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## **2.9 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## **PART 3 - EXECUTION**

### **3.1 HANGER AND SUPPORT APPLICATIONS**

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
  
- B. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
  
- C. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

- D. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- F. Use padded hangers for piping that is subject to scratching galvanic or electrolysis erosion.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  - 4. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for all insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

- M. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  5. Insert Material: Length at least as long as protective shield.
  6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.4 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.5 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### **3.6 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
  
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

## SECTION 23 0593

### 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 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
  - 1. Air Systems:
    - a. Constant-volume air system.
    - b. Variable-volume air systems.
  - 2. Reporting results of activities and procedures specified in this Section.

##### 1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- J. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

- K. TAB: Testing, adjusting, and balancing.
- L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

#### **1.4 SUBMITTALS**

- A. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

#### **1.5 QUALITY ASSURANCE**

- A. Testing, adjusting and balancing (TAB) of the air conditioning systems and related ancillary equipment shall be performed by an impartial technically qualified TAB firm selected and employed by the Owner, separate and apart from the construction contract. TAB Firm Qualifications: Engage a TAB firm certified by, NEBB or TABB.
- B. TAB shall provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems.
  - 1. Where field verification is called for, the CxA will notify Contractor 4 days in advance of the date of field verification. Notice will not include data points to be verified.
  - 2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.7.2.3 - "System Balancing."

## **1.6 PROJECT CONDITIONS**

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **1.7 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

## **1.8 WARRANTY**

- A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
  - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
  - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.



- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gages, automatic and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine equipment for installation and for properly operating safety interlocks and controls.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.2 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  1. Permanent electrical power wiring is complete.
  2. Automatic temperature-control systems are operational.
  3. Equipment and duct access doors are securely closed.
  4. Balance, smoke, and fire dampers are open.

5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
  1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

### **3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

### 3.5 PROCEDURE FOR DUCT SYSTEM LEAKAGE TESTING

- A. Leakage of the duct system shall not exceed 10% of total design airflow. The testing procedure shall be based on ASTM E1554, Standard Test Methods for Determining External Air Leakage of Air Distribution Systems by Fan Pressurization. Testing shall be performed by the Test and Balance contractor approved by the owner and Engineer. Documentation verifying duct leakage of less than 10% shall be submitted with the Final Testing Report.

### 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 fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and air-treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  - 4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  - 5. 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 modes 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 static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - 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. Remeasure 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 terminal 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 terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using 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

### **3.7 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Electric-Heating Coils: Measure the following data for each coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
- B. Refrigerant Coils: Measure the following data for each coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Refrigerant suction pressure and temperature.

### **3.8 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS**

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure, adjust, and record the pressurization building by adjusting the relief airflows to achieve the indicated conditions.
- C. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the relief airflow to achieve the indicated pressure or airflow difference.
- D. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
  - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
  - 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization and observe and report on the system's ability to revert to the set point.
  - 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

- E. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- F. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

### **3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS**

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### **3.10 TEMPERATURE-CONTROL VERIFICATION**

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### **3.11 TOLERANCES**

- A. Set HVAC system airflow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
  - 2. Air Outlets and Inlets: 0 to minus 10 percent.

### 3.12 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB firm.
  - 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 firm 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, type size, and fittings.
  - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
  - 15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outside-, 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.
- E. System Diagrams: Include schematic layouts of air distribution system. Present each system with single-line diagram and include the following:
  - 1. Quantities of outside, supply, return, and exhaust airflows.  
Duct, outlet, and inlet sizes.
  - 2. Pipe and valve sizes and location
  - 3. Position of balancing devices.

- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    - 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  2. Motor Data:
    - a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.
    - f. Preheat coil static-pressure differential in inches wg.
    - g. Cooling coil static-pressure differential in inches wg.
    - h. Outside airflow in cfm.
    - i. Outside-air damper position.
    - j. Return-air damper position.
    - k. Vortex damper position.
- G. 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.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outside-air, wet- and dry-bulb temperatures in deg F.
    - e. Return-air, wet- and dry-bulb temperatures in deg F.
    - f. Entering-air, wet- and dry-bulb temperatures in deg F.
    - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    - h. Refrigerant expansion valve and refrigerant types.
    - i. Refrigerant suction pressure in psig.
    - j. Refrigerant suction temperature in deg F.

- H. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  - 2. Motor Data:
    - a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - g. Number of belts, make, and size.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
  
- I. 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.
    - e. Duct size in inches.
    - f. Duct area in sq. ft.
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
  
- J. 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. Airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.



### **3.13 INSPECTIONS**

- A. Initial Inspection:
  - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
  - 2. Randomly check the following for each system:
    - a. Measure airflow of at least 10 percent of air outlets.
    - b. Measure water flow of at least 5 percent of terminals.
    - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    - d. Measure sound levels at two locations.
    - e. Measure space pressure of at least 10 percent of locations.
    - f. Verify that balancing devices are marked with final balance position.
    - g. Note deviations to the Contract Documents in the Final Report.
  
- B. Final Inspection:
  - 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
  - 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
  - 3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
  - 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
  - 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
  - 7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

### **3.14 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
  
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

**END OF SECTION**

## SECTION 23 0700

### HVAC INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Flexible elastomeric.
    - b. Mineral fiber.
  - 2. Insulating cements.
  - 3. Adhesives.
  - 4. Mastics.
  - 5. Sealants.
  - 6. Factory-applied jackets.
  - 7. Field-applied fabric-reinforcing mesh.
  - 8. Field-applied jackets.
  - 9. Tapes.
  - 10. Securements.
  - 11. Corner angles.

##### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 4. Detail application of field-applied jackets.
  - 5. Detail application at linkages of control devices.
  - 6. Detail field application for each equipment type.

##### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles where insulating materials shall be applied.
- 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

- I. Sizes shown on the drawings are free area dimensions (after installation of duct liner)
- J. Acceptable product for lining rectangular section ducts and plenums: Johns Manville "Permacote Linacoustic R-300" or approved equal.

## **2.2 INSULATING CEMENTS**

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

## **2.3 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  - 2. 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  - 2. 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).

## **2.4 MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.

- e. Mon-Eco Industries, Inc.; 55-40.
  - f. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-10.
    - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    - d. Marathon Industries, Inc.; 550.
    - e. Mon-Eco Industries, Inc.; 55-50.
    - f. Vimasco Corporation; WC-1/WC-5.
  - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
  - 4. Solids Content: 63 percent by volume and 73 percent by weight.
  - 5. Color: White.

## 2.5 SEALANTS

- A. Joint Sealants:
- 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-76.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Pittsburgh Corning Corporation; Pittseal 444.
    - f. Vimasco Corporation; 750.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Permanently flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 5. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76-8.
    - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Vimasco Corporation; 750.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: Aluminum.

## **2.6 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

## **2.7 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Aluminum Jacket: Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
  - 1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
  - 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

## **2.8 SECUREMENTS**

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products; Bands.
    - b. PABCO Metals Corporation; Bands.
    - c. RPR Products, Inc.; Bands.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
  - 1. Manufacturers: Subject to compliance with requirements:
    - a. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

## **2.9 CORNER ANGLES**

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
  - 5. Provide rigid insulation at all duct and pipe hangers, at all hanger locations.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install 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 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### **3.3 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.



- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Pipe: Install insulation continuously through floor penetrations.
  - 3. Seal penetrations through fire-rated assemblies.

### **3.4 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on equipment:
1. Install pipe insulation to outer diameter of equipment and pipe flanges.
  2. Make width of insulation section same as overall width of equipment and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of equipment insulation and outer circumference of adjacent straight pipe segments, flanges and fittings with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to equipment and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
  
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### **3.8 FINISHES**

- A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with flat white paint system identified.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.9 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
  2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.10 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply, return and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in nonconditioned space.
  4. Indoor, concealed return air plenums.

### **3.11 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE**

- A. Service: Indoor, concealed rectangular and round, supply, return, and outside-air ducts.
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 2 inches.
  - 3. Density: 1 lb/cu. ft.
  - 4. k value: 0.27 at 75 Degrees F
  - 5. Number of Layers: One.
  - 6. Vapor Barrier: Provide a vapor barrier on all supply and outside air ductwork
  - 7. Jacket: factory-applied FSK jacket

### **3.12 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Underground piping.
  - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### **3.13 PIPING INSULATION SCHEDULE**

- A. Refrigerant Suction and Hot-Gas Piping concealed inside the building:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Insulation Material: Flexible elastomeric
    - b. Insulation Thickness: 1 ½" inches
    - c. Minimum K value @ 75 Deg F: 0.20
    - d. Jacket: None
    - e. Vapor Retarder Required: Yes
- B. Refrigerant Suction and Hot-Gas Piping Exposed outside the building:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Insulation Material: Flexible elastomeric
    - b. Insulation Thickness: 1 ½" inches
    - c. Minimum K value @ 75 Deg F: 0.20
    - d. Jacket: Aluminum
    - e. Vapor Retarder Required: Yes

**END OF SECTION**

**DIRECT DIGITAL CONTROLS FOR  
LOCAL BUILDING AUTOMATION SYSTEMS  
TRIDIUM-BACNET WEB-BASED –SECTION 230926a**

**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. Division 23
  - 1. General Mechanical Requirements
  - 2. Mechanical equipment
  - 3. Piping
  - 4. Variable Frequency Drives (VFDs)
  - 5. Building Automation System Commissioning Requirements
- C. Division 26
  - 1. General Electrical Requirements
  - 2. Raceways
  - 3. Disconnect Switches
  - 4. Wiring
- D. Division 27
  - 1. Telecommunications cabling
- E. Division 28
  - 1. Fire Alarm Systems.
- F. Mechanical and electrical drawings: Specifications and drawings are complementary to each other and binding. What is called for by one shall be binding as if called for by both. Should there be a conflict between drawings and specifications regarding a material shown of work described or detailed then the material of work having the greater value shall be provided.

1.2 SUMMARY

- A. Provide all hardware, software, materials, labor, and programming for the implementation of a complete standalone Local Building Automation System (BAS) for control of HVAC systems and components.
- B. The system shall consist of a network of microprocessor-based, peer-to-peer, networked, distributed devices utilizing the BACnet communication protocol in an open, interoperable system. The system shall include all wiring and control devices, sensors, actuators, valves, dampers, and hardware required for a complete operational system that will achieve the control sequences specified.
- C. Provide all programming to achieve specified operational sequences, and development of graphical screens, setup of schedules, trends, logs, alarms, network management, and operational connection of the Network Control Unit (NCU) to the local area network.

- D. Access to the Building Automation System for configuration and monitoring shall be performed via a Network Control Unit (NCU) connected to the LAN or WAN.
- E. All components of the system shall be BACnet Testing Laboratories (BTL) Certified.
- F. System design shall follow pertinent and applicable BACnet guidelines. Controllers that require a master computer or controller to perform basic functions are not acceptable. In the event of a network communication failure, or the loss of any other controller on the BACnet network, the control system shall continue to independently operate under control of the resident program stored in nonvolatile memory as detailed herein.
- G. The network infrastructure shall conform to the BACnet published guidelines for network wiring and system architecture. Wire type, distance, termination, and use of routers shall strictly conform to the BACnet wiring standards. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.
- H. Mechanical equipment controllers shall include all control points and achieve all control sequences specified while operating under stand-alone control, independently of connection to the network manager.
- I. Provide DDC system shop drawings and submittals, participate in submittal review meetings, and obtain final approval of submittal from Owner and Engineer prior to installation of system.
- J. Fully test system prior to requesting installation inspection and pre-functional testing by Owner, Engineer, and Commissioning Authority.
- K. Schedule competent technical personnel to participate in Commissioning activities.
- L. Provide a Schedule of Values for work of this section, that includes the following:
  - 1. Submittals (5%)
  - 2. Materials (35%)
  - 3. Installation (35%)
  - 4. Installation Verification with Owner's CxA (5%)
  - 5. Programming & Graphics (10%)
  - 6. Point check out and Commissioning with Owner's CxA (5%)
  - 7. Final O&Ms and As-Built Documentation (5%)

### 1.3 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
  - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
  - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
  - 3. Object Command: Reaction time of less than ten seconds between operator command of a binary object and device reaction.
  - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within eight to ten seconds.
  - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
  - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.



7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.

#### 1.4 ACCEPTABLE CONTRACTORS

- A. Pending compliance with this specification, the following firms have been deemed acceptable contractors for the products and services herein specified:
  1. Tempset Controls
  2. Johnson Controls
  3. Trane
  4. Others must request approval from Owner and Engineer, including
    - a. Statement of compliance with every aspect of this specification;
    - b. Preliminary submittal in accordance with Paragraph 1.5 –specific to the particular project being bid.
- B. Contractor responsible for work under this Section shall be a local factory certified office of the manufacturer of control systems located within 75-mile radius from the job site. Experience requirements below apply only to the local factory certified office.
- C. Contractor shall have, as a minimum, five (5) years of documented continuous business experience in the installation of controls, instrumentation and Energy Management Systems.
- D. Contractor's local personnel conducting work of this section shall have a minimum of three (3) years of experience in the installation of BACnet systems. Personnel conducting work shall be:
  1. Tridium Niagara N4 Certified
  2. BACnet Certified Professional

Contractor shall provide evidence of certifications upon request.

- E. The installing office shall provide a list of completed and accepted BACnet job references. The references shall include one job from each of the Three (3) years required.
- F. Each reference shall include the following: the job name, the job size, the owner with address, contact name and phone number, the general contractor, the mechanical contractor, and the contracting company's system programmer name(s).
- G. The Contractor's BACnet Certified personnel shall be directly responsible for all work related to:
  1. System design
  2. Submittals
  3. Programming
  4. Installation Supervision
  5. Calibration
  6. Checkout
  7. Commissioning.

#### 1.5 SUBMITTALS

- A. Refer to Division-1 Submittals and Division-23 General Mechanical Work for additional submittal requirements.

- B. Scope of Work Summary: Include in submittal package a clear written summary of the scope of control work, including but not limited to the following:
1. Integration with the existing systems (if any) at the facility;
  2. Scope of demolition work (if any)
  3. Systems to be controlled as part of this work, clearly stating which systems will receive full DDC systems, and which (if any) will receive only timeclock control.
  4. Evidence of coordination with manufacturers of equipment provided under the mechanical and electrical scope of work to verify that all required control points and sequences will be implemented, regardless of whether the DDC controls reside in a controller provided by the equipment manufacturer or the controls contractor.
- C. Product Data:
1. DDC System Hardware:
    - a. Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
    - b. Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  2. Network Control Devices and System Software:
    - a. Include technical data for operating system software, service maintenance agreement and device/point count license details.
    - b. Provide legally licensed copies of all software tools, configuration tools, management tools, and utilities used during system installation and commissioning.
  3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
  4. Cabling: Technical data sheets for all cables.
- D. Shop Drawings:
1. Include AISD Project Number on Cover Page.
  2. Include specification section and revision on Cover Page.
  3. Single-line schematic diagram, top-level subsystem, depicting the network architecture. The top-level subsystem shall illustrate the network media, channel transceiver types, subsystems, network interfaces, Human Machine Interfaces (HMI), repeaters, and terminators if utilized.
  4. Floor plan diagrams of the building shall indicate unit and unit controller locations, room numbers or area names and space sensor locations and a diagram of how the BACnet Network wiring is routed from the Building Controller to all of the BACnet controllers.
  5. System diagrams for each system and subsystem, including power supply through starters and motors; motor starting and interlock wiring; pushbuttons; all control wiring; interior electrical circuits of control instruments with terminal designations; control motors; colors of wires; wire tags and tag numbers, location of router, controllers, instruments and remote elements; horsepower of motors; normal position of valves, dampers, and relays. A detailed description of the operation of the control system,

including control device designation, shall accompany the drawings. The drawings shall include a floor plan and riser diagram of the school indicating unit locations, sensor locations, areas served by each piece of equipment and BACnet Network and Sub-network wiring details with routing of all communication cables.

6. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  7. Details of control panel faces, including controls, instruments, and labeling.
  8. Schedule of dampers including size, leakage, and flow characteristics.
  9. Schedule of valves including flow characteristics.
  10. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  11. Controlled Systems:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram. In the event the sequences proposed by Engineer are unclear, incomplete, or known to be non-compliant with Owner's requirements, Contractor shall issue a Request For Information (RFI) document prior to preparing submittals.
    - d. Points list: Provide a complete list of all input and output points, alarms, setpoints and schedules that will be transmitted to and from the Web Server. This point list shall include points to be obtained from BACnet Controllers provided by equipment manufacturers.
- E. Preliminary Submittal (Shop Drawings and Product Data)
1. Prepare a Preliminary Submittal for review by Owner, Engineer, and Commissioning Authority.
  2. Make arrangements with General and Mechanical Contractors to transmit Preliminary Submittal electronically to all recipients simultaneously, with no paper copy to follow.
  3. Shop Drawings and Product Data shall be submitted at the same time but as separate files.
  4. Request a Preliminary Submittal Review meeting with General Contractor, Mechanical Contractor, Owner, Engineer, and Commissioning Authority no less than six (6) days after transmittal. This time is required for review by all parties.
  5. Contractor shall lead the Preliminary Submittal Review Meeting to address at least the following:
    - a. Owner, Engineer, and Commissioning Authority comments;
    - b. Resolution to any pending RFI's related to control work;
    - c. Final coordination of any controls provided by equipment manufacturers (in which case manufacturers should be asked to attend meeting as well)
    - d. Review Submittal Checklist
    - e. Timeline for final submittal.
- F. Final Submittal (Shop Drawings and Product Data)
1. Prepare Final Submittal after addressing all issues discussed during Preliminary Submittal Review Meeting.

2. Allow six (6) days for review by Owner, Engineer and Commissioning Authority.
3. Do not proceed with installation prior to receiving notification of submittal approval.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. At the time of Functional Testing, update submittal data to reflect condition of systems as installed and programmed.
- B. Make any final revisions made during Functional Testing with Owner and Commissioning Authority.
- C. Submit ALL requirements listed under Paragraph 1.6 Submittals, as part of the Operation and Maintenance Manual. Include warranty start date.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Refer to Paragraph 1.5.
- B. 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.
- C. Installation in accordance with all codes and local ordinances. Refer to Part 3 of this specification for additional installation requirements.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

#### 1.9 COORDINATION

- A. Prior to preparing submittals, coordinate location of control devices and routing of wiring with plans and room and equipment details. For retrofit applications, conduct a detailed inspection of the site and equipment to receive controls in order to identify optimal locations for devices, mounting of controllers, and routing of wiring.
- B. It is the intent of this specification that the Section 230926 Contractor shall be responsible for all power and control wiring and raceways associated with the turnkey operational installation of the DDC system. Prior to submittals, coordinate with any additional power requirements that require the involvement of the Division 26 Contractor.
- C. Coordinate with other Division 23 Contractors and equipment suppliers for control of mechanical equipment. It is the intent of this specification that the Section 230926 Contractor shall assume responsibility for a turnkey fully operational control system that includes interfacing with controls integral to equipment –whether via conventional electro-mechanical control or BACnet interfaces.
- D. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Division 26 Section "Motor-Control Centers" and "Variable Frequency Controllers" to achieve compatibility with motor starters and annunciation devices.

## 1.10 WARRANTY

- A. The entire BACnet network controls system including wiring, controllers, controlling devices, sensing devices, integral components, service and labor will be warranted for one (1) year from date of system acceptance date unless the manufactures warranty extends beyond the one (1) year warranty. The warranty will then be as indicated by the manufacture of the product.
- B. System acceptance date starts upon successful completion of Functional Testing, as determined by Commissioning Authority.
- C. If corrective software and/or hardware modifications are made during the warranty period, the BAS controls contractor shall update all user documentation, user and manufacturer archived CD ROM and software disks.

## 1.11 TRAINING

- A. Provide a minimum of **16 hours** of training to AISD personnel. The number of individuals selected for training shall be at the sole discretion of AISD.
- B. Training shall cover all aspects of the specified controls system from system overview and operation to basic trouble-shooting. Training shall include a mix of classroom and actual hands on instruction to include but not limited to training during commissioning of BACnet nodes on site and application specific at the BAS system contractor's local office. Training shall include a minimum of eight (8) hours of classroom and eight (8) hours of field training on the newly installed control system. At AISD's discretion, the training may be mixed to allow for more or less time in the classroom or field training areas.
- C. The BAS System Contractor shall create an agenda for the training class and submit it for approval by AISD Energy Management Department before training classes are scheduled.
- D. Provide all training manuals, materials, and operator and maintenance manuals as required.

## 1.12 CODES AND STANDARDS

- A. The completed and operational BAS shall be in compliance with and meet the requirements of all governing bodies, Authorities Having Jurisdiction (AHJ), applicable local or national standards and codes, except where more stringent or detailed requirements are indicated by the Contract Documents, including the requirements set forth in this Specification and the following:
  - 1. ASHRAE 135-2016: BACnet -Building and Air Conditioning Engineers (ASHRAE)
  - 2. Underwriters Laboratories UL-916: Energy Management Systems (EMS)
  - 3. NIST IR 6392 Annex B: Profiles of Standard BACnet Devices
  - 4. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for Use in Balanced Digital Multi-Point System.

**PART 2 - PRODUCTS****2.1 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES**

- A. The intent of this specification is to provide a peer-to-peer networked, distributed control system using ANSI/ASHRAE Standard 135-2016, BACnet technology communication protocols, in an open, interoperable system. The direct digital control (DDC) system shall consist of BACnet based microprocessor-based controllers, plus instrumentation, control valves, dampers, operators, control devices, interface equipment, network manager, BACnet communication interfaces, and other apparatus required to operate systems and perform functions specified. The DDC system shall be capable of providing total integration of the facility infrastructure systems with user access to all system data via Human Machine Interface (HMI) using a Web Browser such as Internet Explorer™, Mozilla Firefox™ or Google Chrome™ connected to the system network using the LAN or WAN.

**2.2 NETWORKS**

- A. The system architecture shall support the following levels.
  - 1. Master Slave/Token Passing (MS/TP)
  - 2. BACnet IP (B/IP)
- B. Local area network minimum physical and media access requirements:
  - 1. Ethernet; IEEE standard 802.3u
  - 2. Cable; 100 Base-T, UTP-8 wire, Category 5e
  - 3. Minimum throughput; 100 Mbps

**2.3 GRAPHICAL USER INTERFACE (GUI) SOFTWARE**

- A. Graphical User Interface: Provide a software tool that allows for the development and management of the end users' Graphical User Interface (GUI) and as the primary point of access to the BAS for the end user.
- B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, log-off button and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
- C. Real Time Displays: The GUI shall at a minimum support the following features and functions:
  - 1. Graphic screens shall be developed using any drawing package capable of generating or assembling objects from a GIF, JPG, PNG or ICO file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
  - 2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

3. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
  4. Schedule and holiday times shall be adjusted using a graphical calendar.
  5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu.
  6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value.
- D. System Configuration: At a minimum the GUI shall permit the operator to perform the following tasks with proper password access:
1. Create, delete or modify control strategies
  2. Add/delete objects to the system
  3. Tune control loops through the adjustment of control parameters
  4. Enable or disable control strategies
  5. Override inputs and outputs (permanent and timed)
  6. Generate hard copy records or control strategies on a printer
  7. Select point to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Security: Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- H. Alarm Console:
1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
  2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

## 2.4 WEB BROWSER CLIENTS

- A. A web browser shall be the primary means of access to the BAS for day to day operation from any PC connected to the LAN and remote via internet without the need for any proprietary software.
- B. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Mozilla Firefox™ or Google Chrome™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
  - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
  - 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
  - 3. HTML programming shall not be required to display system graphics or data on a Web page.
  - 4. Storage of the graphical screens shall be in the Network Control Unit (NCU), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
  - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
  - 6. User shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
    - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
    - b. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
    - c. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
    - d. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
    - e. View logs and charts.
    - f. View and acknowledge alarms.
    - g. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
    - h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.



## 2.5 NETWORK CONTROL UNITS

- A. The Network Control Unit (NCU) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NCU.
- B. The NCU shall be capable of executing application control programs to provide:
  - 1. Calendar functions
  - 2. Scheduling
  - 3. Trending
  - 4. Alarm monitoring and routing
  - 5. Time synchronization
  - 6. Integration of BACnet controller data
  - 7. Network management functions for all BACnet based devices.
- C. The NCU must provide the following hardware features as a minimum:
  - 1. 1000Mhz Processor
  - 2. 1GB DDR-3 SDRAM
  - 3. 4GB Flash Memory
  - 4. Wi-Fi Connectivity IEEE802.11a/b/g/n
  - 5. Two 10/100MB Ethernet Ports
  - 6. Two Isolated RS-485 Ports
  - 7. One USB Type A Connector
  - 8. Real Time Clock
  - 9. Support of up to Four IO/Communication Expansion Modules
- D. The NCU shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NCU shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- E. The Network Control Unit will provide all scheduling, alarming, trending, and network management for the all BACnet devices.
- F. Provide multiple Network Control Units as necessary. The NCU shall support a minimum of 128 BACnet controllers. In order to maintain peak performance of the network, no more than 110 BACnet controllers may be connected to a single NCU and no more than 64 BACnet controllers per NCU Communication Trunk. In any event, no more than 70% of the available resources of the NCU (as indicated by the resource meter of the programming tools for the NCU) shall be committed. In the event that the available resources are less than 30%, the number of nodes connected to the NCU shall be reduced in order to maintain a 30% or greater buffer of resources within the NCU.
- G. The NCU shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 5 simultaneous users.
- H. Event Alarm Notification and actions - The NCU shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers. The NCU shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
  - 1. Alarm generation shall be selectable for annunciation type and acknowledgement; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers. The NCU shall be able to route any

alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.

- a. To Alarm
  - b. Return to normal
  - c. To fault
2. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
  3. Provide timed (schedule) routing of alarms by class, object, group, or node.
  4. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control. Control equipment and network failures shall be treated as alarms and annunciated.
  5. Alarms shall be annunciated in any of the following manners as defined by the user, but implemented by this contractor:
    - a. Screen message on screen
    - b. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      - 1) Day of week
      - 2) Time of day
      - 3) Recipient
    - c. Pagers via paging services that initiate a page on receipt of email message.
    - d. Graphic with flashing alarm object(s).
    - e. Printed message, routed directly to a dedicated alarm printer.
  6. The following shall be recorded by the NCU for each alarm (at a minimum):
    - a. Time and date
    - b. Equipment (Air handler #, pump, etc)
    - c. Acknowledge time, date and user who acknowledged
    - d. Number of occurrences since last acknowledgement
  7. Alarm actions may be initiated by user defined programmable objects created for that purpose.
  8. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
  9. A log of all alarms shall be maintained by the NCU and/or a server (if configured in the system) and shall be available for review by the user.
  10. Provide a “query” feature to allow review of specific alarms by user defined parameters.
  11. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
  12. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
- I. Acceptable Products:
1. JACE-8000:
    - a. Niagara N4 Version 4.2
    - b. Open License NiCS (Vendor Neutral, No Vendor Locking)
    - c. Embedded Workbench
    - d. 40% Minimum Spare Capacity (Devices & Points)
    - e. 5-Year SMA (Software Maintenance Agreement)
- J. Data Collection and Storage

1. The NCU shall have the ability to collect data for any property of any object and store this data for future use.
  2. The data collection shall be performed by log objects, resident in the NCU that shall have, at a minimum, the following configurable properties:
    - a. Designating the log as interval or deviation.
    - b. For interval logs, the object shall be configured for time of day, day of weeks and the sample collection interval.
    - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
    - d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
    - e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
  3. All log data shall be stored in a relational database in the NCU and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements. All log data shall be available to the user in the following data formats:
    - a. HTML
    - b. XML
    - c. Plain Text
    - d. Comma or tab separated value
  4. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
  5. The NCU shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NCU on the network. Provide the ability to configure the following archiving properties, at a minimum:
    - a. Archive when the log has reached its user-defined capacity of data stores
    - b. Archive on time of day
    - c. Archive on user-defined number of data stores in the log (buffer size)
    - d. Provide ability to clear logs once archived
  6. Provide and maintain an Audit Log that tracks all activities performed on the NCU. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NCU), to another NCU on the network, or to a server. For each log entry, provide the following data:
    - a. Time and date
    - b. User ID
    - c. Change or activity; i.e. change setpoint, add or delete objects, commands, etc.
- K. Database Backup and Storage
1. The NCU as provided shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval. Copies of the current database and, at the most recently saved database shall be stored in the NCU. The age of the most recently saved database is dependent on the user-defined database save interval. The NCU database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2. Provide all tools necessary for the development, maintenance, expansion and use of the BAS described within these specifications. All software tools shall be compatible with the network management tool (workbench) that is provided as part of this project. For the purpose of this specification software tools shall be divided into the following categories and meet these specified requirements.
- L. NCU Programming Wizards for LCU/TCU Controllers
1. Provide Wizards or objects that facilitate the programming and configuration of the local Control Unit (LCU) and terminal Control Unit (TCU) Controllers sequence of operation through a menu driven wizard. All software tools (including Wizards) shall be compatible with the network management tool (workbench) that is provided as part of this project. The programming and configuration tools shall perform the following functions:
    - a. LCU Controllers programming shall be accomplished by Graphical programming language (GPL) where objects are used to define different portions of the control sequence. All control sequences programmed into the controller shall be stored in non-volatile memory. Systems that only allow selection of sequences from a library or table are not acceptable. All code must be exportable to a library for future use.
    - b. TCU Controllers – Provide for the programming of the required sequence of operation through an intuitive menu driven selection process. The configuration tools menu shall define items such as I/O configurations, set point, delays, PID loops, optimum start stops, and network variables settings. The configuration tool must indicate the device status and allows system override. Or, provide for the programming of the required sequence of operation through Graphical programming language (GPL) where objects are used to define different portions of the control sequence. All control sequences programmed into the controller shall be stored in non-volatile memory. Systems that only allow selection of sequences from a library or table are not acceptable. All code must be exportable to a library for future use.
- M. NCU Network Management Software Tools
1. Provide a complete set of Network Management tools that provides for the development and management of BACnet networks.
  2. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
  3. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
  4. These tools shall provide the ability to “discover” existing BACnet networks, regardless of what network management tool(s) were used to install the existing network, so that existing BACnet devices and newly added devices are part of a single network management database.
  5. The network management database shall be resident in the NCU and with proper authorization, shall allow access to the network management database. Systems employing network management databases that are not resident in the NCU, shall not be accepted.
  6. System shall allow access to all of the Network Management tool functions including controller programming from a Web Browser.
- N. NCU Programming Software

1. Provide programming software for the Network Control Unit that allows for the development of the NCU control logic, point management, global properties such as alarm, trend and scheduling.
  2. All library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Access to these functions shall be provided through Graphical User Interface software (GUI). Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.
  3. Programming Methods – Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
    - a. Configuration of each object will be done through the object’s property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
    - b. The software shall provide the ability to view the logic in an off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
    - c. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
    - d. The system shall support object duplication within a customer’s database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.
- O. NCU Object Library
1. A standard library of software objects that represent functions and applications for the development and setup of application logic, user interface displays, system services, and communication networks.
  2. The objects in this library shall be capable of being copied and pasted into the user’s database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
  3. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

## 2.6 LOCAL CONTROL UNITS, TERMINAL CONTROL UNITS, INTEGRATED SPACE SENSORS

### A. General

1. All controllers provided as part of this system and used for indoor applications shall operate under ambient environmental conditions of 32 degF (0 degC) to 122 degF (50 degC) dry bulb and 5% to 90% relative humidity, non-condensing as a minimum.
2. All controllers provided as part of this system and used for outdoor applications shall operate under ambient environmental conditions of -40 degF (-40 degC) to 158 degF (70 degC) dry bulb and 5% to 90% relative humidity, non-condensing as a minimum.

### B. System Design

1. Local Control Units (LCU) shall be utilized for primary mechanical and electrical systems such as Air handling equipment, Make-up Air Unit, Boiler System Control, and Chiller System Control type of applications.
2. Terminal Control Units (TCU) shall be utilized for terminal equipment, such as Variable Air Volume, Fan Coil, Heat Pump, Roof Top applications.
3. Each LCU and TCU controller shall have a minimum of 10% spare capacity of each point type for future points. As a minimum, each controller shall have one spare of each point type available on the controller.
4. The LCU and TCU controller programming or configuration tools shall be fully accessible through the Operator Workstation and Web Browser Client through the use of Wizards. Provide Wizards or objects as specified in NCU paragraph that facilitate the programming and configuration of the LCU and TCU through a menu driven wizard.

### C. Controller Local Area Network (BAS sub LAN)

1. Provide a network of stand-alone, distributed direct digital controller that operate on ANSI/ASHRAE Standard 135-2016 BACnet communication protocol.
2. Provide BAS Controllers that utilize BACnet technology and are BTL certified. Controllers using proprietary protocols are unacceptable.
3. The design of the BAS sub-LAN shall network Local Control Unit (LCU) and Terminal Control Unit (TCU) to a Network Control Unit (NCU).
4. This level of communication shall support a family of application specific controllers and shall communicate bi-directionally with the network through DDC Controllers for transmission of global data.
5. Terminal Control Unit (TCU) shall be arranged on the BAS sub-LAN's in a functional relationship manner with Local Control Unit (LCU). Ensure that a Variable Air Volume (VAV) Terminal Control Unit (TCU) is logically on the same LAN or segment as the Local Control Unit (LCU) that is controlling its corresponding Air Handling Unit (AHU).

### D. Local Control Units (LCU)

1. The Local Control Units (LCU) shall be 32 bits microprocessor-based. They shall also be multi-tasking, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the project point list.
2. Each LCU shall have sufficient memory, to support its own operating system and databases, including:
  - a. Control processes

- b. Energy management applications
  - c. Alarm management applications
  - d. Historical/trend data for points specified
  - e. Maintenance support applications
  - f. Custom processes
  - g. Manual override monitoring
3. Each LCU shall support:
- a. Analog inputs of 4-20 mA, 0-10 Vdc, 10,000 ohm thermistor or 1000 ohm RTD.
  - b. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
  - c. Each LCU shall be capable of providing the following control outputs without the addition of equipment outside the DDC controller cabinet:
    - 1) Digital outputs (contact closure for motor starters up to size 4)
    - 2) Analog outputs of 4-20 mA or 0-10 VDC
  - d. The LCU analog or universal input shall use a 16 bit A/D converter.
  - e. The LCU analog or universal output shall use a 10 bit D/A converter.
  - f. Each output shall have supervised manual override switch and a potentiometer or integrated LCD operator interface (preferred).
  - g. Each LCU shall have a minimum of 10% spare capacity for each point type for future point connection. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring. As a minimum, provide one of each type of point available on the controller.
  - h. Provide sufficient internal memory for the specified control sequences and have at least 25% of the memory available for future use.
  - i. Each controller shall perform its primary control function independent of other NCU controller LAN communication, or if LAN communication is interrupted. Reversion to a fail-safe mode of operation during LAN interruption is not acceptable. The controller shall receive its real-time data from the NCU controller time clock to insure LAN continuity. Each controller shall include algorithms incorporating proportional, integral, and derivative (PID) gains for all applications. All programmed PID gains and biases shall be available for adjustment via the NCU field-adjustable by the user via terminals as specified herein.
  - j. The LCU shall provide local status indication for each output for constant, up-to-date verification of all point conditions via dedicated LEDs or built-in LCD operator interface without the need for an operator handheld device.
  - k. The LCU shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
  - l. Should the LCU memory be lost for any reason, the user shall have the capability of reloading the controller software via the NCU Controller. Direct connection to LCU controller for reloading controller software is not acceptable.
  - m. Multiplexer boards that convert an analog input into several digital inputs such as the DUIC-5P board are not permitted and shall not be used without explicit authorization from the AISD Energy Management Department.

#### E. LCU Programming Software

1. Provide programming software for the Local Control Unit (LCU) that allows for the development of the LCU control logic and point management.
  2. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Access to these functions shall be provided through Graphical User Interface software (GUI). Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.
  3. Programming Methods –Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification.
    - a. Configuration of each object will be done through the object’s property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
    - b. The software shall provide the ability to view the logic with value being inputted/outputted of the graphical blocks (debug mode).
    - c. The system shall support object duplication within a customer’s database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.
  4. Provide function to compare and calculate from multiple values from networked controllers (NCU, TCU and/or LCU). As a minimum, the function shall calculate and compare the values and return the average, sum, highest, lowest, 3 highest and 3 lowest values.
- F. Terminal Control Units (TCU)
1. Provide Terminal Control Units (TCU) for control of each piece of terminal equipment.
  2. The Terminal Control Units (TCU) shall be 32 bit microprocessor-based. They shall also be multi-tasking, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the project point list.
  3. Each TCU shall have sufficient memory, to support its own operating system and databases, including:
    - a. Control processes
    - b. Maintenance support applications
    - c. Custom processes
    - d. Manual override monitoring



4. Each TCU shall support:
  - a. Analog inputs of 4-20 mA, 0-10 Vdc, 10,000 ohm thermistor or 1000 ohm RTD
  - b. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
  - c. Each TCU shall be capable of providing the following control outputs without the addition of equipment:
    - 1) Digital outputs (contact closure for motor starters up to size 4)
    - 2) Analog outputs of 4-20 mA or 0-10 VDC
5. The TCU analog or universal input shall use a 16 bit A/D converter.
6. The TCU analog or universal output shall use a 10 bit D/A converter.
7. Controllers shall include all point inputs and outputs necessary to perform the specific control sequences. As a minimum, 25% of the point outputs shall be of the universal type; that is, the outputs may be utilized either as modulating or two-state, allowing for additional system flexibility. Analog outputs shall be industry standard signals such as 24V floating control, allowing for interface to a variety of modulating actuators.
8. Each TCU controller performing space temperature control shall be provided with a matching room temperature sensor.
9. Each controller shall perform its primary control function independent of other NCU controller LAN communication, or if LAN communication is interrupted. Reversion to a fail-safe mode of operation during LAN interruption is not acceptable. The controller shall receive its real-time data from the NCU controller time clock to insure LAN continuity. Each controller shall include algorithms incorporating proportional, integral, and derivative (PID) gains for all applications. All programmed PID gains and biases shall be available for adjustment via the NCU field-adjustable by the user via terminals as specified herein.
10. Provide each TCU with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Operating programs shall be field selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.
11. VAV Terminal Control Units:
  - a. The VAV box TCU controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 20 to 28 VAC ( $\pm 15\%$ ), allowing for power source fluctuations and voltage drops. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range. The controllers shall also function normally under ambient conditions of 32 degF to 122 degF (0 degC to 50 degC) and 5% to 90% RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
  - b. The Variable Air Volume (VAV) Terminal Control Unit (TCU) shall include a built-in differential pressure transducer that shall connect to the VAV terminal unit manufacturer's standard differential pressure sensor to measure the average and amplify differential pressure in the duct. The controller shall convert this value to actual air flow. Single point differential pressure sensing device is not acceptable. The VAV TCU differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. (0 to 250 Pa) and measurement accuracy

- of "5% at 0.1 to 1 in. W.C. (25 to 250 Pa) and a minimum resolution of 0.0001 in. W.C. (0.025 Pa), insuring primary air flow conditions shall be controlled and maintained to within "5% of setpoint at the specified minimum and maximum air flow parameters. The VAV TCU differential pressure transducer shall have a zero value air flow measurement repeatability of 0.001 in. W.C. (0.25 Pa), VAV TCU differential pressure transducer requiring periodic zero value air flow calibration is not acceptable. The BAS contractor shall verify the type of differential pressure sensors used in the existing boxes, and ensure compatibility with the VAV TCU controllers.
- c. The Variable Air Volume (VAV) Terminal Control Unit (TCU) shall include provision for air flow balancing using a local air flow balancing interface. A portable air flow balancing interface or an Intelligent Space Sensor (ISS) capable of balancing air flow is acceptable. The portable air flow balancing interface shall connect to the VAV TCU or the matching room temperature sensor.
  - d. The Variable Air Volume (VAV) Terminal Control Unit (TCU) shall also provide a web browser based air flow balancing tool. This tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, close all VAV dampers.
  - e. The VAV box controller shall interface to a matching room temperature sensor as previously specified. The controller shall function to maintain space temperature to within "1.5 degF (0.9 degC) of setpoint at the room sensor location. Each controller shall also incorporate an algorithm that allows for resetting of the associated air handling unit discharge temperature if required to satisfy space requirements. This algorithm shall function to signal the respective DDC controller to perform the required discharge temperature reset in order to maintain space temperature setpoint.
  - f. It shall be possible to view and reset the space temperature, temperature setpoint, maximum airflow setting, minimum airflow setting, and actual airflow, through the BAS LAN.
12. TCU Thermostat
- a. Provide Terminal Control Unit (TCU) Thermostat controllers designed with unique functions and features particular to a specific type of mechanical equipment or applications that may be less common and or standardized in its use and application.
  - b. TCU Thermostat – A self-contained controller with a built-in user interface that is intended for installation in the occupied space of the building. The TCU Thermostat shall have the following features:
    - 1) The TCU Thermostat shall be a microprocessor-based fully-programmable controller with all of its control logic, inputs and outputs, network communication and user interface provided within the manufacturer provided enclosure specific to the application. The enclosure shall be aesthetically appealing with a modern design that will fit in with the architecture of the building. A sample of the TCU Thermostat shall be provided as part of the submittal process.
    - 2) The TCU Thermostat shall be programmed through the user interface contained within the controller and through a software based configuration tool.

- 3) The user interface display shall be provided with 3 levels of password protection: Level 1 – Lockout with view only and time adjustment; Level 2 - schedule override and mode settings; Level 3 – full access to all parameters. Where required in the sequence of operation provide for within Level 2 access the ability to change the units of measure displayed for temperature from Fahrenheit to Celsius. The display shall be back lighted for easy viewing.
  - 4) If required within the sequence of operation, provide for a control schedule and time clock within the TCU Thermostat. The control schedule shall provide for a separate schedule for each day of the week with 4 events per day. The real time clock will have a six hour power reserve time.
  - 5) The TCU Thermostat shall utilize a PI (proportional and integral) control algorithm. Upon power failure, all programmed schedules and parameters must be retained in non-volatile flash memory.
  - 6) Each TCU Thermostat shall be capable of providing the following control inputs and outputs without the addition of equipment:
    - a) One (1) on-board thermistor
    - b) Four (4) universal inputs (0-10VDC, thermistor, dry-contact)
    - c) Five (5) universal outputs (0-10VDC or dry-contact N.O.)
13. Multiplexer boards that convert an analog input into several digital inputs such as the DUIC-5P board are not permitted and shall not be used without explicit authorization from the AISD Energy Management Department.

G. TCU Programming Software

1. Provide programming software for the Terminal Control Unit (TCU) that allows for the development of the TCU control logic and point management.
2. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Access to these functions shall be provided through Graphical User Interface software (GUI). Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.
3. Programming Methods - Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification.
4. Configuration of each object will be done through the object’s property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

5. The software shall provide the ability to view the logic with value being inputted/outputted of the graphical blocks (debug mode).
6. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.
7. Provides function to compare and calculate from multiple values from networked controllers (NCU, TCU and/or LCU). As a minimum, the function shall calculate and compared the values and return the average, sum, highest and lowest values.

#### H. TCU Configuration Software

1. Configuration of the TCU controller shall be done through the configuration tool using fill-in the blank fields, list boxes, and selection buttons.
2. The configuration tool menu shall define items such as I/O configurations, set point, delays, PID loops, optimum start stops, and network variables/object settings. The configuration tool shall indicate the device status and allows system override.
3. The Configurable Controller shall allow the use of its spare I/O as dumb I/O to be shared over the network to other Controllers such as Programmable Controllers, where a sequence of operation can be applied to the I/O. Such applications shall include but not be limited to exhaust fan control, heaters, lighting control, etc.

#### I. Acceptable Manufacturers/Products

1. Distech
2. Johnson Controls
3. Trane.

## 2.7 ELECTRONIC INPUT/OUTPUT DEVICES

### A. Sensors and Transmitters

1. Provide sensors and transmitters required as outlined in the input/output summary and sequence of operation, as required to achieve the specified accuracy as specified herein.
2. Temperature transmitters shall be equipped with individual zero and span adjustments. The zero and span adjustments shall be non-interactive to permit calibration without iterative operations. Provide a loop test signal to aid in sensor calibration.
3. Temperature transmitters shall be sized and constructed to be compatible with the medium to be monitored. Transmitters shall be equipped with a linearization circuit to compensate for non-linearity of the sensor and bridge and provide a true linear output signal.
4. Temperature sensors shall be of the resistance type and shall be either three-wire 100 ohm platinum RTD, or two-wire 1000 ohm platinum RTD.
5. Thermistors are acceptable provided the mathematical relationship of a thermistor with respect to resistance and temperature with the thermistor fitting constraints is contained with the Control Unit (CU) operating software and the listed accuracy's can be obtained. Submit proof of the software mathematical equation and thermistor manufacturer fitting constants used in the thermistor mathematical expressions. Thermistors shall be of the negative thermistor coefficient (NTC) type with a minimum of 100-Ohm/°F resistance change versus temperature to insure good

resolution and accuracy. Veris or approved equal. AISD prefers 10K Type II Thermistors.

- 6. Combination Sensors or “Combo Sensors” such as Temperature and Humidity or CO2 and Humidity are not permitted and shall not be used without prior authorization from AISD Energy Management Department.
- 7. The following point type accuracies are required and include errors associated with the sensor, lead wire and A to D conversion.

<u>Sensor Type</u>	<u>Range</u>	<u>Min. Accuracy</u>
Duct/AHU Temperature	40 – 130°F	± 0.5 Degree F
Room Temperature	50 – 85°F	± 0.5 Degree F
Outside Air Temperature	-20 – 120°F	± 0.5 Degree F
Chilled Water Temperature	32 – 80°F	± 0.5 Degree F
Hot Water Temperature	80 – 220°F	± 0.5 Degree F
Humidity	0 – 100%	± 3% RH
Duct Static Pressure	0 – 3” w.c.	± 1% full scale per 50°F
Space Static Pressure	- 0.25” – 0.25” w.c.	± 1% full scale per 50°F
Current Sensor	Sized for application	± 1% full scale
Power (kWh)	Sized for application	± 2% full scale (at 1.0 PF)
Air Flow	700 – 4,000fpm	± 2% full scale
Water Flow	Sized for application	± 4% full scale
CO <sub>2</sub> Sensors	0 – 2,000 PPM	± 3% full scale

- 8. Sensors shall not drift more than 1% of full scale per year.
- 9. Sensors used in British Thermal Unit (BTU) or process calculations shall be accurate to ±0.10°F over the process temperature range. Submit a manufacturer's calibration report indicating that the calibration certification is traceable to the National Institute of Standards and Technology (NIST).
- 10. Thermowells
  - a. When thermowells are required, the sensor and well shall be supplied as a complete assembly.
  - b. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.
  - c. Thermowells and sensors shall be mounted in a threadlet or ½” NPT saddle and allow easy access to the sensor for repair or replacement.
  - d. Thermowells shall be constructed of the following materials:
    - 1) Chilled and Hot Water; 316 stainless steel
    - 2) Condenser Water and Steam; 316 stainless steel
    - 3) Brine (salt solutions); marine grade stainless steel
    - 4) Heat transfer grease shall be used on all thermowell applications.
- 11. Space Temperature Sensors
  - a. Each room sensor shall include the following options:
    - 1) Style: Delta style.
    - 2) Setpoint Adjustment: The setpoint adjustment slider shall allow for modification of the temperature by the occupant. Each Setpoint Slider shall be adjustable for allowable range from the Graphic User Interface. Default [+/-3F].
    - 3) Setpoint Adjustment Slider Graduation: “Cool/Warm”
    - 4) Setpoint Adjust Slider Acting: Direct Acting
    - 5) Temperature Indicator: Do Not Provide.

- 6) Override Switch: Required. In parallel with sensor.
  - 7) Foam-backing: Provide for sensors mounted on exterior walls, CMU walls, structure beams or if sensor reading is being affected by air draft in wall.
12. Outside Air Sensors
    - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall be provided with a solar shield.
    - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate surrounding the sensor element.
    - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
  13. Duct Type Sensors
    - a. Duct mount sensors shall mount using a handy box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (seal-tight fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.
    - b. Duct sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate. Sensor probes shall be constructed using 304-rated stainless steel.
    - c. Duct sensor shall be of the appropriate length and mounted in a location on the duct to obtain the best representation of the actual air temperature.
    - d. For outdoor air duct applications, use a weatherproof box with weatherproof cover and gasket.
    - e. Sensor handy box shall not be used as a pull-box. Installation shall allow the replacement of sensor without the need for disconnecting/removing additional wiring or conduit.
  14. Averaging Duct Type Sensors
    - a. Provide capillary supports at the sides of the duct to support the sensing string. Support the middle of the span to prevent flopping of the capillary tube as required. No metal-to-metal contact shall be allowed.
    - b. Where the capillary enters the equipment, it shall be protected from sharp edges using a poly tube sleeve.
  15. Relative Humidity Sensors/Transmitter
    - a. The sensor shall be a solid state, resistance type relative humidity sensor of the bulk polymer design. The sensor element shall be washable and resist surface contaminations.
    - b. Humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2 wire isolated loop powered, 4-20ma, 0-10 VDC linear proportional output.
    - c. The humidity transmitter shall meet the following overall accuracy including lead loss and A to D conversion.
      - 1) Room Type Sensor  $\pm 3\%$  RH
      - 2) Duct Type Sensor  $\pm 3\%$  RH
    - d. Outside air relative humidity sensors shall be installed in a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with seal-tight fittings and stainless steel bushings.
    - e. Provide a single point humidity calibrator, if required, for field calibration. Transmitters shall be pre-calibrated from factory.

- f. Duct type sensing probes shall be constructed of 304 stainless steel and be equipped with a neoprene grommet, bushings and a mounting bracket.
16. Differential Pressure Transmitters and Accessories
- a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
  - b. Pressure transmitters shall provide the option to transmit a 0-5 VDC, 0-10 VDC, or 4-20 mA output signals.
  - c. Pressure transmitters shall be equipped with a LED display indicating the transmitter output signal.
  - d. Differential pressure transmitters used for pressure or flow measurement shall be supplied with shutoff and bleed valves in the high and low sensing pick-up lines (5 valve manifolds).
  - e. Provide, at a minimum, a NEMA-1 housing for the transmitter. Locate transmitters in accessible local control panels wherever possible.
  - f. Duct sensing pressure applications shall utilize a static pressure traverse probes.
17. Low Air Pressure Applications
- a. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the room and reference static pressure input signals with the following minimum performance specifications.
    - 1) Span: No greater than two times the design space differential pressure
    - 2) Accuracy:  $\pm 0.5\%$  of full scale
    - 3) Dead Band: Less than 0.3% of output
    - 4) Repeatability: Within 0.2% of output
    - 5) Linearity:  $\pm 0.2\%$  of span
    - 6) Response: Less than one second for full span input
    - 7) Temperature Stability: Less than 0.01% output shift per degree change
  - b. The transmitter shall utilize variable capacitance sensor technology and be immune to shock and vibration.
  - c. Measuring of outside air pressure shall be accomplished by using a pressure pickup probe suitable for outdoor pressure sampling that stabilizes and reduces fluctuations from wind gusts.
  - d. Measuring of indoor space pressure shall be accomplished by using a static pressure pickup probe either wall or ceiling mounted.
18. Medium to High Air Pressure Applications
- a. The pressure transmitter shall be similar to the low air pressure transmitter. Provide differential pressure transmitters, which meet the following performance requirements:
    - 1) Zero & Span: (% full scale/degree): 0.041% including linearity, hysteresis and repeatability
    - 2) Accuracy: 1% full scale (best straight line)
    - 3) Static Pressure Effect: 0.5% full scale
    - 4) Thermal Effects:  $<\pm 0.03\%$  full scale/degree
19. Low Differential, Water Pressure Applications
- a. The differential pressure transmitter shall be of industrial grade and transmit a linear output signal in response to variation of differential pressure or water pressure sensing points.

- b. The differential pressure transmitter shall meet the following performance specifications:
    - 1) Die-cast NEMA-4 Enclosure with readout LCD display
    - 2) Suitable input differential pressure range
    - 3) Dual sensor design
    - 4) Microprocessor profiled with built-in noise rejection
    - 5) 0-10VDC, 0-5VDC or 4-20mA output
    - 6) Maintain accuracy up to 20 to 1 ratio turndown
    - 7) Reference Accuracy:  $\pm 0.2\%$  of full span
    - 8) Push-button auto-zero
    - 9) Provide with bypass/test manifold
  - c. Differential pressure transmitters with wired remote sensors are not to be used without the prior approval from AISD Energy Management Department.
20. Medium to High Differential Water Pressure Applications
- a. The differential pressure transmitter shall meet the low-pressure transmitter specifications except the following:
    - 1) Differential pressure range.
    - 2) Reference Accuracy:  $\pm 1\%$  of full span (includes non-linearity, hysteresis, and repeatability)
21. Bypass Valve Assembly Actuators
- a. Electronic actuators shall be direct-coupled type capable of being mounted over the shaft of the damper or valve. They shall be approved by a suitable safety or regulatory agency. Power consumption shall not exceed 8 watts or 15 VA of transformer sizing capacity per high torque actuator nor 2 watts or 4 VA for VAV actuators. Sound level shall not exceed 45 dB for high torque or 35 dB for VAV actuators.
  - b. Electronic overload protection shall protect actuator motor from damage. If the damper jams, the actuator shall not burn out. Internal end switch type actuators are not acceptable. Actuators may be mechanically and electrically paralleled on the same shaft to multiply the available torque. A reversing switch shall be provided to change action from direct to reverse in relation to control signal as operation requires.
  - c. All bypass valves shall provide a position feedback to the control system.
  - d. All 120 VAC powered actuators shall be installed with a locking switch (key operated switch, Leviton 1221-2L) as a disconnection means for servicing within reach of the actuator, but not on the actuator. Verify location with Architect, Engineer, and/or Owner prior to install.
22. Intelligent Space Static Pressure Sensors:
- a. Intelligent space static pressure sensors shall meet but not be limited to the following:
    - 1) Low pressure type differential pressure transmitter
    - 2) Integrated Neuron Chip controller
    - 3) TP/FT-10 network transceiver
    - 4) Integral power supply for transmitter controller and transceiver

B. Valve and Damper Actuators

- 1. Electronic Valve and Damper Actuators
  - a. Electronic actuators shall be direct-coupled type capable of being mounted over the shaft of the damper or valve. They shall be approved by a suitable safety or



- regulatory agency. Power consumption shall not exceed 8 watts or 15 VA of transformer sizing capacity per high torque actuator nor 2 watts or 4 VA for VAV actuators. Sound level shall not exceed 45 dB for high torque or 35 dB for VAV actuators.
- b. Electronic overload protection shall protect actuator motor from damage. If damper jams actuator shall not burnout. Internal end switch type actuators are not acceptable. Actuators may be mechanically and electrically paralleled on the same shaft to multiply the available torque. A reversing switch shall be provided to change action from direct to reverse in relation to control signal as operation requires.
  - c. All 120 VAC powered actuators shall be installed with a locking switch (key operated switch, Leviton 1221-2L) as a disconnecting means for servicing within reach of the actuator, but not on the actuator. Verify location with Architect, Engineer, and/or Owner prior to install.
2. Control Damper Actuators
    - a. Outside air, return air, and exhaust air actuators shall be spring return type for safety functions. Individual battery backup or capacitor return is not acceptable. With approval, a central battery pack system similar to a uninterruptible power system may be used with a battery checking circuit connected to the DDC automation system. Daily verification of battery performance shall be incorporated in the programming.
    - b. The control circuit shall be fully modulating using 0–10VDC, 2–10VDC, 4 - 20 mA, or pulse width modulation signals. Accuracy and repeatability shall be within  $\pm 1/21$  of control signal. A 0–10VDC, 2-10VDC, or 4 - 20 ma signal shall be produced by the actuator which is directly proportional to the shaft clamp position which can be used to control actuators paralleled off a master motor or to provide a feedback signal to the automation system indicating damper position. Accuracy shall be within  $\pm 2.5\%$ .
    - c. Face and bypass dampers and other control dampers shall be modulating using the same control circuit detailed above but shall not be spring return.
  3. Miscellaneous Damper Actuators
    - a. Outside air combusting and ventilation air intake and exhaust damper actuators shall be 2 position (open/close) spring return, and close if any water piping, coils or other equipment in the space which the damper serves needs to be protected from freezing.
    - b. Provide auxiliary switches on damper shaft or blade switch to prove damper has opened on all air handling equipment handling 100% outside air and greater than 2.5" total static pressure.
  4. Air Terminals
    - a. Air terminal actuators shall be fully modulating floating (drive open, drive closed) 3 wire control or use control circuit as detailed in control dampers depending on the controllers requirements.
  5. Inlet Vanes Actuators
    - a. Inlet vanes and actuators shall not be used for this job. Speed control of the fan motor shall use a variable frequency drive (VFD).
  6. Combination Smoke and Fire Damper Actuators
    - a. Actuators shall be factory mounted and connected to the damper section and conform to suitable safety or regulatory agency approved specifications.

7. Valve Actuators
  - a. Actuators shall have a gear release button on all non-spring return models to allow manual setting. The actuator shall have either an insulating air gap between it and the linkage or a non-conducting thermoplastic linkage. Care shall be taken to maintain the actuator's operating temperatures and humidity within its specifications. Pipes shall be fully insulated and heat shields shall be installed if necessary. Mount actuators so condensation shall not form on actuators and be prevented by a combination of insulation, air gap, or other thermal break.
  - b. The control circuit shall be fully modulating using 0–10VDC, 2-10VDC, 4 - 20 mA, or pulse width modulation signals. Accuracy and repeatability shall be within 1/21 of control signal. A 0-10, 2-10VDC, or 4-20 mA signal shall be produced by the actuator which is directly proportional to the shaft clamp position which can be used to control actuators paralleled off a master motor or to provide a feedback signal to the automation system indicating valve position.
  - c. Valve body and actuators shall be equipped fully assembled and tested at the valve factory.
  - d. All 120 VAC powered actuators shall be installed with a locking switch (key operated switch, Leviton 1221-2L) as a disconnecting means for servicing within reach of the actuator, but not on the actuator. Verify location with Architect, Engineer, and/or Owner prior to install.
  - e. All actuators shall be provided with means to accept a ½” conduit fitting.
8. Control Valve Actuators (4 inch and larger)
  - a. The Valve actuator shall consist of a permanent split capacitor, reversible type electric motor that drives a compound epicycle gear. The electric actuator shall have visual mechanical position indication, readable from a distance, and show output shaft and valve position. Unit shall be mounted directly to the valves without brackets and adapters, or readily adapted to suit all other types of quarter-turn valves.
  - b. The actuator shall have an integral terminal strip, which, through conduit entries, will ensure simple wiring to power supplies. Cable entries should be approved by a suitable safety or regulatory agency. Use recommended gland stops within the NPT hole to prevent glands from being screwed in too far and damaging cable.
  - c. The actuator shall be constructed to withstand high shock and vibrations without operations failure. The actuator cover shall have captive bolts to eliminate loss of bolts when removing the cover from the base. One copy of the wiring diagram shall be provided with the actuator.
  - d. The actuator shall have a self-locking gear train that is permanently lubricated at the factory. The gearing shall be run on ball and needle bearings. Actuators with high output torque shall have two adjustable factory calibrated mechanical torque limit single-pole double-throw switch type. The motor shall be fitted with thermal overload protection. The motor rotor shaft shall run in ball bearings at each end of motor.
  - e. The actuator housing shall be hard anodized aluminum for full environmental protection.
  - f. The actuator shall be provided with means for manual override.
  - g. The environmental temperature range of the actuator shall be from –30°C to +60°C (-20°F to +140°F).

- h. For intermittent on/off service, the actuator shall be rated at a 20% duty cycle (i.e., 12 minutes extended duty in every hour, or alternatively; one complete cycle every 2 minutes). For more frequent cycling and modulating service, an actuator shall be rated for continuous duty. The actuator rated for continuous duty shall be capable of operating 100% of the time at an ambient temperature of 40°C.
  - i. The actuator shall have an integral self-locking gear train. Motor brakes shall not be required to maintain desired valve position. Levers or latches shall not be required to engage or disengage the manual override. Mechanical travel stops, adjustable to 15° in each direction of 90° rotation shall be standard, as well as two adjustable travel limit switches with electrically isolated contacts. Additional adjustable switches shall be available as an option.
  - j. Single Phase Motor: The motor shall have Class B insulation capable of withstanding locked-rotor for 25 seconds without overheating. Wiring shall also be Class B insulation. An auto-reset thermal cutout protector shall be embedded in the motor windings to limit heat rise to 80°C in a 40°C ambient. All motors shall be capable of being replaced by simply disconnecting the wires and then removing mounting bolts. Disassembly of gears shall not be required to remove the motor.
  - k. Materials of Construction: The electric actuator shall have a pressure die-cast, hard-anodized aluminum base and cover. The compound gear shall be made of die-cast, hard-anodized aluminum or steel. An alloy steel worm gear shall be provided for manual override and torque limiting. Bearings for gears shall be of the ball and needle type; bronze bearings shall be used on the shafting parts.
  - l. Accessories: Potentiometer for providing continuous feedback of actuator position at the CU (for valves specified position feedback).
  - m. All 120 VAC powered actuators shall be installed with a locking switch (key operated switch, Leviton 1221-2L) as a disconnecting means for servicing within reach of the actuator, but not on the actuator. Verify location with Architect, Engineer, and/or Owner prior to install.
9. Variable Frequency Drives (VFD)
- a. Refer to division 23 and 26 for approved list of VFDs and other requirements.
  - b. The VFD shall communicate utilizing the BACnet protocol via manufacturer card to communicate and receive data through the DDC system. All VFDs shall have separate conduits for hi-voltage input circuits, hi-voltage output circuits and control circuits. In addition to the BACnet communications, each drive shall have two hard-wired points from the BAS system. The two points are as follows:
    - 1) VFD start/stop
    - 2) VFD speed input
  - c. Remote mounted VFDs with service disconnects between the VFD and the load, shall be wired to the service disconnect early-break auxiliary switch for proper VFD shutdown upon disconnect operation.

#### C. OTHER ACCESSORIES

- 1. Electric Low Limit Thermostat (Freeze Stat)
  - a. Heavy-duty, duct type, fixed differential, vapor-charged sensing element, manual reset, with test/reset button.

- b. Sensing element shall be a capillary tube responding to the lowest temperature sensed along any segment of bulb length. Switch shall be rated for 10 amps at full load DPDT (double-pole double-throw).
  - c. The capillary tube shall be protected from damage at the location that it enters the AHU. Any exposed areas of the capillary tube shall be protected by covering with poly- tubing. Refer to Averaging sensors section above. Provide one 20-foot long bulb thermostat for every 20-sq.ft of coil area.
  - d. Adjustable Range: 15 to 55 degree F.
  - e. AISD prefers Johnson Controls A70 Series Low Limit Thermostats.
2. Water Flow Switches
    - a. Suitable safety or regulatory agency approved device, suitable for all service application conditions. Body minimum working pressure rating shall equal or exceed service pressure. Unit shall have two single-pole double-throw switches. Actuating flow rated shall be field adjustable for the specified and indicated service. Switch location shall preclude exposure to turbulent or pulsating flow conditions. Flow switch shall not cause pressure drop at maximum system flow rate.
  3. Strap-On Aqua stat
    - a. Strap-on aqua stats are not to be used without the prior approval from AISD Energy Management Department.

#### D. FLOW, PRESSURE AND ELECTRICAL MEASURING APPARATUS

1. Traverse Probe Air Flow Measuring Stations
  - a. Traverse probes shall be a dual manifold, cylindrical, type constructed of 3003 extruded aluminum with an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching airflow and without the physical presence of forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tips on opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as  $\pm 20^\circ$  in the approaching air stream.
  - b. The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presences in the airstreams. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
  - c. Traverse probes shall be accurate to  $\pm 2.5\%$  of the measured airflow range and be installed in a duct section that meets manufacturer's installation specifications sheet. Allow adequate distance from elbows, junctions or other disturbances.
2. Shielded Static Pressure Sensor
  - a. Provide for each zone where required a shielded static pressure sensor suitable for ceiling surface mounting, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, compression takeoff fittings, all contained in a welded stainless steel casing, with polish finish on the exposed surfaces.

- b. These probes shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow from a radial source.
  - c. The shielded static sensing devices shall be used for both reference and space pressure sensing.
  - d. Pressure sensors used for outside air pressure reference purposes shall be equipped with a conduit seal for pneumatic tubing and bushings for a weather tight installation.
  - e. All sensors shall be installed according to the manufacturer's installation specifications sheet and in a location that is not subject to frequent air disturbance.
3. Static Pressure Traverse Probe
- a. Provide multipoint traverse probes in the duct at each point where static pressure sensing is required.
  - b. Each duct static traverse probe shall contain multiple static pressure sensors located along the exterior surface of the cylindrical probe. Pressure sensing points shall not protrude beyond the surface of the probe.
  - c. The duct static traverse probe shall be of 304 stainless steel construction and be complete with threaded end support rod, sealing washer and nut, and mounting plate with gasket and static pressure signal fitting. The static traverse probe shall be capable of producing a steady, non-pulsating signal of standard static pressure levels without the need for correction factors, and an instrument accuracy of 5% full range.
  - d. The probe shall be installed according to the manufacturer's installation specifications sheet and in a location that is not subject to frequent air disturbance.
4. Flow Meters
- a. Electronic Type Flow Meters: (ONICON F-Series Manufacturer or approved equal)
    - 1) Accuracy of flow meter shall be  $\pm 0.5\%$  of reading at calibrated velocity with a pressure drop of less than 1 PSI at 20 ft/s in 1.5" pipe, decreasing in larger pipes and lower velocities.
    - 2) Electronic sensing method shall be electromagnetic.
    - 3) Insertion-type for renovation projects.
    - 4) Inline-type for projects involving new hydronic piping or piping reconfiguration.
    - 5) The standard temperature range shall be 180° F continuous, 200° F peak. High temperature range shall be 280° F continuous, 300° F peak with an operating pressure of 400 PSI maximum.
    - 6) The flow meter shall be wet-calibrated at the manufacturer's laboratory against primary volumetric standards directly traceable to NIST. Provide certification of calibration with each meter.
    - 7) Input signal from flow meter to be 0-10VDC or 4-20mA.
    - 8) Insertion-type meters shall be installed to allow removal of meter removal during system operation.
  - b. Venturi Type Flow Meters:
    - 1) Pressure drop on venturi type flow meters shall not exceed 0.25" WC. Each venturi low and high-pressure taps shall be equipped with nipples, valves, and quick disconnects.

- 2) Equip each venturi with a metal identification tag indicating the size, location, flow (gpm), and meter reading for the flow specified.
  - 3) Provide (1) dial differential pressure meter of the proper range to determine piping system flow rate. The meter shall become the property of AISD.
  - 4) Venturi meters shall utilize flanged or screwed connections for removal purposes and shall be rated for the system operating pressures.
  - 5) The venturi flow meter shall be factory calibrated to provide a minimum of flow accuracy between actual and factory flow calibration data.
5. Current Transformers
- a. The current transformers shall be designed to be installed or removed without dismantling the primary bus or cables. The transformer shall be of a split core design. Solid core current transformers shall not be used without the prior approval from the AISD Energy Management Department.
  - b. The core and windings shall be completely encased in a suitable safety or regulatory agency approved thermoplastic rated 94VA. No metal parts shall be exposed other than the terminals.
  - c. The current transformers shall meet the following specifications:
    - 1) Frequency Limits: 20 to 100 Hz
    - 2) Insulation: 0.6 KV Class, 10 KV BIL
    - 3) Accuracy:  $\pm 1\%$  at 5.0 to 25.0 VA accuracy class with U.P.F burden
6. Current Sensing Switches
- a. The split core current sensing switch shall be self-powered with solid-state circuitry. Current sensing switches shall consist of a solid state current sensing circuit, adjustable trip point, solid state switch, single-pole double-throw or double-pole double-throw relay, as required and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device and looped if required to attain the correct sensing value. The current sensing switch shall accept over current up to twice its trip into range.
  - b. It shall be reverse voltage protected and have high over current capability.
  - c. Frequency Limits: 20 to 100 Hz.
  - d. Accuracy:  $\pm 0.5\%$  of full scale.
  - e. Response Time: 300 milliseconds to 90% of step change.
7. Power Monitoring
- a. Wattnode BACnet or approved equal.
  - b. Current transformers rated and as required for proper interfacing to electrical gear scheduled to be monitored.
  - c. Provide voltage disconnect switch and CT shorting block equal to ELKOR i-BLOCK or approved equal.
  - d. Install in dedicated control panel.

## 2.8 CONTROL VALVES AND DAMPERS

### A. General Control Valve Requirements

1. All automatic control valves shall be linear, fully proportioning, with modulating ball, plug or V-port inner guidelines unless otherwise specified. The valves shall be quiet in operation and fail safe in either normally open, normally closed position or fail in

last commanded state in the event of loss of electronic output signal. See drawings and sequence of operation for system requirements.

2. All valves shall be capable of operating per sequence when required by the sequence of operation. All control valves shall be sized by the BAS system contractor and/or the valve manufacturer, and shall be guaranteed to meet the heating and cooling loads as specified. All control valves shall be suitable for the pressure conditions, and shall close against the differential pressures involved. Valve body pressure rating and connection type (screwed or flanged) shall conform to ANSI pressure classifications appropriate for the system working pressures.
  3. All valves shall be programmed to be 0% on HMI = 0 signal on DDC controller = Valve Closed to Coil. Likewise, 100% on HMI = 100% Signal (10VDC, 20ma, etc) on DDC controller = Valve Open to Coil. Same holds true for Dampers (Multizone dampers shall be 0% = Full Hot Deck, 100% = Full Cold Deck). Any deviation from this strategy shall require permission from Owner during the 90% Submittal review.
- B. Steam Control Valves: AISD has phased out all steam generating equipment.
- C. Hot and Cold Water Control Valves
1. Hot and cold water globe type control valves shall be single-seated type, with equal percentage flow characteristics. The valve discs shall be composition type and shall be sized using ISA methods.
  2. Pressure drop through the valves shall not exceed 5 PSI when the valve is fully open and under design flow unless otherwise indicated
  3. Ball valves shall be equipped with 316 stainless steel trim, Teflon seals and adjustable packing gland nuts. Provide a handle for manual operation during start-up and maintenance.
- D. Air Terminal Reheat Valves
1. Reheat valves shall be modulating logarithmic equal percentage type globe or ball valves as detailed in paragraph C above. 2-position control is not acceptable.
- E. Two Position Control Valves
1. For open/closed and/or three-way diverting applications, butterfly valves are acceptable and shall be heavy-duty pattern with a body rating comparable to the pipe rating.
  2. Provide each butterfly valve with a replaceable lining suitable for temperature and service requirements.
  3. Equip each with a butterfly valve with disc and stainless steel stem.
  4. Valves used for shut-off or isolation purposes shall be bubble-tight.
- F. Automatic Control Dampers
1. Automatic dampers shall give a feedback of position only when noted in contract documents.
  2. Automatic dampers shall have multiple blades and sized for the application by the BAS Contractor and/or as indicated on the design drawings.
  3. Submit a schedule of damper sizes to the Prime Contractor, with a copy to the Architect/Engineer and AISD within 15 days after being awarded the contract.
  4. Dampers used for throttling airflow shall be opposed blade type arranged for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear. Multi-section dampers must be provided

- with sufficient interconnecting hardware or jackshaft for unison operation of all blades in the entire assembly.
5. Damper frames and blades shall be constructed of either minimum 16 gauge galvanized steel or 14 gauge aluminum and arranged to facilitate field assembly of several individual sections into a larger damper area and allow secure fastening of damper frame to the surrounding ductwork, collar or fan housing. Maximum blade length in any section shall not be longer than 48 inches. Additional stiffening or bracing shall be provided for any section exceeding 48 inches in height.
  6. Damper blades shall not exceed eight (8) inches in width. All blades except for fume hood exhaust systems shall be galvanized sheet steel. Blades shall be suitable for high velocity performance.
  7. All damper bearings to be made of nylon. Bushings that turn in the bearing are to be oil impregnated sintered metal. Dampers shall be tight closing, low leakage type with synthetic elastomer seals on the blade edges and on the top, bottom and sides of the frame. Dampers shall not leak in excess of 8 cubic feet per minute per square foot when closing against 4 inches water gauge static pressure.
  8. Leakage and flow characteristic charts shall be submitted to the Architect/Engineer for review.



**PART 3 - EXECUTION****3.1 GENERAL**

- A. Do not proceed with work without approved submittals. Any alterations and/or changes to the control sequences shall be submitted to the Engineer for approval for such changes prior to design of the control system and submittal of control shop drawings. AISD Energy Management Department to review and comment on shop drawings before work begins. All work performed prior to submittal approval shall be at contractor's own risk.
- B. Provide all hardware, software, programming, materials, labor, licenses, permits and incidentals necessary to provide completely operational digital controls systems. Perform start up and commissioning on each control product, system, and subsystem to provide fully operable systems in accordance with the specified functional performance.
- C. Comply with applicable codes and ordinances. If any conflict arises between these specifications and drawings or codes and ordinances, immediately notify the Architect/Engineer and AISD. Do not deviate from the drawings and specifications nor install any work which may be in conflict with codes and ordinances until the conflict is resolved and the solution accepted by the Architect/Engineer and AISD.
- D. The BAS System Contractor is responsible for providing a complete and operational system as described in the description of operation, in the points lists summary, and/or the mechanical/electrical drawings for this project. Any item referenced in one part of the system documentation but not listed elsewhere shall be covered under contractors pricing (i.e. damper called out in sequence but not indicated on drawings).
- E. The mechanical, electrical, and building automation system drawings show the general arrangement of the respective systems. Follow these drawings, as closely as actual building construction and the work of other trades permit. Provide devices, fittings, and accessories, which may be required but not shown on the drawings or specified herein. Investigate conditions affecting the work and arrange the work accordingly. Provide modifications and accessories as required to meet such conditions.

**3.2 COORDINATION OF WORK**

- A. Examine and compare the BAS specifications and drawings with the specifications and drawings of the other trades and report any discrepancies between them to the Architect/Engineer and AISD. Obtain the Architect/Engineer's written instructions for changes necessary to the BAS work.
- B. Install and coordinate the BAS work in cooperation with the other trades installing interrelated work including mechanical, testing adjusting and balancing, and electrical (including fire alarm) during bidding and submittal process. All changes required in the work of the contractor, caused by inadequate coordination and noncompliance with specifications, shall be made at contractor's expense.
- C. Where control system will interface with controls provided by equipment manufacturers, ensure that coordination takes place such that all sequences and required control and monitoring points are made available. Documentation stating "work by others" is not acceptable. All work must be clearly coordinated.

- D. Carefully check space requirements with other trades to ensure that all material can be installed in the allotted spaces, including above finished suspended ceilings, between coils sections, etc.
- E. Install the BAS work to permit removal (without damage to other parts) of parts requiring periodic replacement or maintenance.
- F. Renovations/Additions: The BAS contractor shall examine the existing controls system and shall become familiar with all pertinent components and functions of the existing system, including any energy management systems. The contractor shall be responsible for including all work necessary for the following:
  - 1. Existing controls that are to remain in operation after this project shall remain in place and be modified only as required to incorporate new controls.
  - 2. The new controls shall be fully compatible with the existing system.
  - 3. The new controls shall be fully interconnected with the existing system.
  - 4. It shall be the responsibility of the Prime contractor to insure the coordination of proper decommissioning and disconnection/removal of old control system components that will not be reused. Old database and sequences of operation shall be cleaned up, old conduit and wiring removed, old devices and controllers salvaged and returned to the AISD Energy Management Department in a timely manner. Any controllers and/or field devices damaged during the removal process shall be repaired and/or replaced at no cost to AISD.

### 3.3 WIRING INSTALLATION

#### A. GENERAL

- 1. BAS contractor shall be responsible for all control and power wiring associated with the control system including any related 120V electrical work that may require interlocks, circuit breakers, and/or connections at the panel boards spares or spaces.
- 2. All electrical work shall be performed in accordance with the requirements of Division 26.
- 3. All wiring shall be run parallel and perpendicular to building lines (no angles) and concealed where possible. All wiring shall be installed in a professional manner and in accordance with the National Electrical Code and local ordinances. Electrical or mechanical inspection sign off does not remove AISD's right to refuse acceptance of the electrical installation for incorrect or noncompliance with NEC and project specifications. Installation must comply with all local control system electrical code requirements.
- 4. The control contractor shall use a licensed, qualified and bonded electrical contractor for all wiring above 24Volts.
- 5. Units already having 120 VAC power run by Division 26 for fans, VAV's, electric heat, etc. shall be provided with required 24 VAC power via a step-down transformer and protected with a circuit breaker, whether provided by the BAS system contractor or unit manufacturer.
- 6. Provide electrical disconnecting means for servicing, for each control panel, digital controller, transformer, power supply, and other devices that are served by 120VAC or higher voltage.
- 7. Raceways:
  - a. Wiring shall be run in EMT conduit in exposed areas and in vertical risers between floors with sleeves and including any new walls or existing walls that

- have additional work being performed. EMT conduit fittings shall be steel compression type. All firewall penetrations shall be caulked with approved fire caulking material.
- b. Low voltage plenum rated wire may be used without conduit in concealed but accessible areas (i.e. above lay-in ceilings) and shall be installed in a professional and workmanship like manner and secured up as high as possible. All wall penetrations by plenum cable shall use sleeves with bushings to avoid sharp edges.
  - c. All conduits on roofs, in areas exposed to weather conditions, in mechanical spaces, and located within six (6) feet above floor level shall be of rigid type conduit with watertight fittings. Use of non-threaded fittings on rigid conduit shall be limited and used only when necessary.
  - d. Underground conduit shall be of the appropriate schedule PVC or coated ridged and back filled per code.
  - e. Where flexible metal conduit is used, the maximum allowable length shall be 36 inches, and the minimum shall be 18 inches. All flex conduit fittings shall be of the compression type. Where conduit is attached to vibrating or rotating equipment, flexible metal conduit with a minimum length of 18 inches and maximum length of 36 inches shall be installed and anchored in such a manner that vibration and equipment noise will not be transmitted to the rigidly mounted conduit. Where exposed to the elements or in damp or wet locations, (such as Mechanical rooms) waterproof flexible metal conduit shall be installed at and below 6 feet above floor level. Installation shall be as specified for flexible metal conduit.
  - f. When in crawl spaces, EMT conduit may be used when kept up high to the structure; otherwise rigid type conduit shall be used. Waterproof flexible metal conduit shall be used in crawl spaces with the above length requirements.
  - g. Provide a pull string in all conduits for pulling spare wire.
  - h. No conduit shall be filled to more than 80% of available space.
8. Coordinate with the Mechanical and Electrical Installation Contractors to ensure controls shall be accessible for repair and maintenance.
  9. Provide supervised field-wiring for all alarm panel monitoring points, asset protection points (safeties, sump pumps, maintenance alarms) and all points identified to include supervised wiring on the points schedule.
  10. Separate Ground: Where recommended by controls manufacturer for the system/application involved, DDC system/components shall employ and maintain a separate, “clean earth” grounding protection. “Mixing” of grounding systems shall be prohibited. (Isolate DDC controls conduits/metal boxes from other raceway systems using isolation bushings and other measures as necessary.)
  11. There shall be no power wiring of 120 volts or higher in the same conduit or raceways with communications or low voltage control wiring
  12. There shall be no power wiring of 120 volts or higher in the same conduit or raceways with communications or low voltage control wiring.
  13. Control wiring shall follow the following coloring conventions:
    - a. Orange: BACnet wiring
    - b. Yellow: Thermostat wiring (wall mounted temperature sensors)
    - c. White: All other field wiring
  14. Hardwired Safety Circuit:
    - a. Hardwired safety alarm monitoring and shutdown shall be accomplished through the use of a Fan Safety Relay Board Model: RIBMNLB-6/-4/-2 manufactured by Functional Devices, Inc. or approved equal. The number of

circuits/size of board (6, 4 or 2) shall be selected accordingly to accommodate all the specified safety devices plus one spare relay/circuit. Each safety device shall be manual-reset and shall be homerun to the safety relay board via dedicated wiring. Daisy-chaining of devices shall only be permitted when more than one device of the same kind is required to accomplish the specified scope of work (i.e. two freeze-stats to cover the entire area of the cooling coil). Safety relay board shall be installed in the associated controls cabinet. Enclosed version of this safety relay board shall not be used. Each relay on the board shall be clearly labeled identifying the function of the circuit (i.e. Freeze-Stat, High-Static, Smoke-Detector, etc). The first dry-contact of the master relay shall be used to shut down the fan(s) of the associated unit via the Starter or VFD. The second dry-contact shall be used to report the general status of the safety circuit back to the BMS. Individual status monitoring of safeties shall be provided if specified in the scope of work.

- b. Units scheduled to receive only one safety device (i.e. float switch), are permitted to be installed without a Fan Safety Relay Board if safety device is not scheduled to be monitored by the BMS for status reporting.
- c. Freeze-stat normally-closed contact shall be homerun to control panel to energize a DPDT (Double-Pole, Double-Throw) relay. First contact shall be wired to Fan Safety Relay Board for Fan Shutdown. Second contact shall be wired to cut power to all spring-return actuators.

B. Wiring less than 30 volts:

- 1. In ceilings of areas where return air plenum is used, plenum rated cable will be allowed unless noted otherwise. Where plenum cable is used, it shall be run parallel with building lines, banded together in bundles, supported without sags or “clothes line” appearance at 5 foot centers or less. Cabling that is not run in a neat fashion shall be removed and reinstalled. Determination of neatness shall be at the discretion of the Owner and Engineer. All plenum rated cabling shall be clearly marked on the outside jacket to indicate “Plenum” service.
- 2. Exposed, unfinished locations, such as mechanical rooms and below accessible raised flooring: Conductors and cable plenum rated (where local code or officials allow). All plenum rated cables shall be in conduit in unfinished area and mechanical rooms starting 6 feet above finished floor.
- 3. Concealed, unfinished locations, such as ceiling plenums, ceiling spaces, shafts, crawl spaces, tunnels: Conductors enclosed in raceway and cable enclosed in raceway or plenum-rated cable (where local code or officials allow).

C. Twisted-Pair Communication Media

- 1. Only use the transceiver manufacturers recommended cable types.
- 2. Install the network communications segments for device channels using bus topology format. Install the network communications segments for all backbone channels using bus topology format.
- 3. Provide all network communication cables, terminations to network control devices and network infrastructure components in accordance with the current requirements of the BACnet Wiring Guide.

D. Control Power Wiring

- 1. BAS system contractor to provide list/location of all control panels requiring 120 VAC power so they may be coordinated with Electrical.

2. The BAS system contractor shall provide final low voltage power supplies and termination of power wiring to network devices and infrastructure components where required.
  3. Provide interlock wiring between supply and return fans, electrical wiring for relays (including power feed) for temperature and pressure indication. Provide interlock wiring between refrigeration machines, pumps and condensing equipment as required for the specified sequence of operation and the refrigeration system integral controller(s). Do not provide interlock wiring if a dedicated digital output has been specified for the equipment or the sequence of operation requires independent start/stop.
  4. Provide power wiring, conduit and connections for low temperature thermostats, high temperature thermostats, alarms, flow switches, actuating devices for temperature, humidity, pressure and flow indication, point resets and user disconnect switches for electric heating, appliances controlled by this division.
- E. Input/Output Control Wiring
1. RTD wiring shall be three-wire or four-wire twisted, shielded, and at a minimum of 18 gauge conductors.
  2. Other analog inputs shall use, twisted, shielded, and at a minimum of 18 gauge conductors.
  3. Binary control function wiring shall use at a minimum of 18 gauge conductors.
  4. Analog output control functions shall be twisted, shielded, and use at a minimum of 18 gauge conductors.
  5. Binary input wiring shall be a minimum of 18 gauge conductors.
  6. Thermistors shall be equipped with the manufacturers calibrated lead wiring.
  7. 120 VAC control wiring shall be minimum of #14 gauge wire, THHN type, in ½” conduit.
- F. Conduit and Fittings
1. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with steel compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections. Rigid steel (RGS) with threaded fittings (connections to junction/outlet boxes and cabinets shall be made with threaded HUBS or double lock-nuts). Provide insulated bushings at all RGS conduit terminations where double lock-nuts are used. The use of Hubs are preferred. The use of threadless RGS fittings shall be kept to a minimum and used only when threading of the GRS is impossible.
  2. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
  3. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
  4. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.
- G. Relays
1. Relays other than those associated with digital output cards shall be general-purpose, enclosed plug-in type protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required. All relays shall be equipped with an LED pilot light. AISD prefers IDEC relays.

2. Solid State Relays (SSR): Solid state relays are not permitted and shall not be used without prior authorization from AISD Energy Management Department.
3. Contactors: Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contractor shall be double-break silver-to-silver type protecting arcing contacts. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

### 3.4 CONTROL PANELS

- A. Enclosed cabinet type with hinged door for mounting controllers, relays, power supplies and miscellaneous control and communication devices.
- B. Control panels shall be fabricated to match the approved shop drawings submitted by the controls contractor. Fabrication shall be in a neat and workmanlike manner and shall facilitate repair, maintenance, and adjustment of the equipment contained therein.
- C. Locate all panels in mechanical or electrical rooms. Submit proposed locations for approval prior to preparing control drawings.
- D. Control panels shall be fabricated and laid out to incorporate the following features:
  1. Lockable doors. All control panels shall be provided with lockable doors using a cylinder AH2 lock kit.
  2. Hinged door shall swing left.
  3. Identification of all internally and cover mounted devices. Cover mounted labels shall be engraved labels as specified in this section.
  4. Provide one duplex outlet mounted inside the control panel. This receptacle may be served from the control panel 120 VAC power source. Label receptacle with source circuit information.
  5. Each control panel shall be provided with a control power disconnect switch located and wired so as to disconnect all control power in the panel. Provide one control power disconnect switch per system served (i.e. two disconnect switches for control panel serving two units).
  6. All control panels containing electrical equipment shall be NEMA rated for the location in which they are installed. Cover mounted components, tubing penetration, and conduit penetrations shall be made in a manner consistent with the NEMA rating.
  7. All conduits entering the control panel shall be fitted with a plastic insulating bushing to prevent cable damage.
  8. Wires and tubes that pass from the panel interior to cover mounted devices shall be provided with a flex loop that is anchored on both sides of the hinge.
  9. All internal wiring and tubing shall run inside plastic open-slot wire ducts. Wire duct shall be sized to hold the required number of wires and tubes without crimping the wires or tubing and with sufficient space to allow wiring and tubing to be traced during troubleshooting operation.
  10. All control panels shall be provided with removable backplane to allow the panel enclosures to be installed at the job site during rough-in while the panels are fabricated off-site for later installation.
  11. Labels serving all input/output wiring shall be installed between the open-slot wire duct and the controller so that labels are visible without removing the covers from the wire ducts. Labels shall be as specified in this section.

12. All wiring inside the panel shall be separated by classification; i.e., Class 1 circuits shall not be run with Class 2 circuits, etc. Segregation shall be maintained inside the panel to the fullest extent possible. Where low voltage wires carrying low level ac and dc signals cross wires containing power and high level ac signals, the wires shall cross at a 90° angle.
  13. 120 VAC power wiring shall enter the panel separately as close to the point of connection as possible
  14. Provide a wireway above or below the control panel whenever more than six conduits enter the panel. Wireway shall be the width of the panel with a minimum of six inches in height and six inches in depth.
- E. Panel Location:
1. Each control panel is to be located for convenient servicing. Top of panel shall be at six foot above finish floor.
  2. Mount panels adjacent to associated equipment.
- F. Network Control Unit (NCU) Panel:
1. Mount in IDF/MDF room or pre-approved location.
  2. Provide one duplex outlet mounted inside the control panel.
  3. Locate NCU power adapter inside the control panel.

### 3.5 TEMPERATURE AND PRESSURE SENSOR INSTALLATION

- A. Temperature and pressure sensors shall require no field calibrations, initial calibration and range set at factory. BAS contractor to calibrate the DDC system with the field sensors. Thermistors are not field calibratable, but still must be field calibrated with the DDC system.
- B. Temperature and pressure sensor assemblies shall be readily accessible and adaptable to each type of application in such manner as to allow for quick, easy replacement and servicing without special tools or skills.
- C. Differential pressure transmitters provided with a LCD readout display shall be mounted on wall at 5-feet AFF and nearby from sampling ports in accessible location.
- D. Differential pressure transmitters intended for control of building chilled water or hot water distribution pumps, shall be hardwired to the Local Control Unit (LCU) in direct control of the associated Variable Frequency Drives.
- E. Sensors installed on units shall be provided with their own dedicated handy box and under no circumstances a sensor shall be “tucked in” or hidden in a junction-box. Installation shall allow the replacement of a sensor without dismantling other sensors, wiring or conduit.
- F. Outdoor installation shall be; of weatherproof construction or in appropriate NEMA enclosures. These installations shall be protected from solar radiation and wind effects. Protective shield shall be stainless steel.
- G. Sensors shall be provided with protective enclosure where located on plans in common areas (hallways, library, cafeteria, gymnasium). Enclosure shall be clear plastic and keyed alike. Key type is C254A as in a Honeywell Versa Guard TG510A 1001. All Gymnasium areas shall use a wire basket type of enclosure.
- H. Sensors in duct shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces or positions obstructed by ducts, equipment, and

so forth. Locations where installed shall be within the vibration and velocity limit of the sensing element. Ducts shall be securely sealed where elements or connections penetrate ducts to avoid measuring false conditions.

- I. All sensors measuring temperatures in pipes larger than 2 inches in diameter or in pressure vessels shall be supplied with wells properly fabricated for the service. Wells shall be non-corrosive to the medium being measured and shall have sufficient physical strength to withstand pressures and velocities to which they are subjected. Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to affect proper flow across the entire area of the well.

### 3.6 INSTALLATION OF ACTUATORS

- A. Where damper motors operate outdoor relief, exhaust and fresh air dampers, pretension damper drive linkage to ensure tight closure.
- B. Do not install damper motors on ductwork of less than 0.76 mm thick without first reinforcing it.
- C. Where a damper motor is installed on an insulated surface of a duct plenum, mount it on a standoff bracket so as not to interfere with the continuity of the insulation.
- D. Locate damper motors so that they are easily accessible for testing and servicing.
- E. Damper motors shall be selected for the torque requirements of the damper. Damper operators that are undersized for the application shall be replaced with larger operators, at no extra cost. On retrofit applications, when existing dampers are suspected to be dragging, the next larger torque actuator shall be used.
- F. Provide one damper motor and linkage for every 2-m<sup>2</sup> damper section area, or as required to meet the torque requirements of the damper under design airflow conditions (or minimum of one damper motor per damper section). Do not use two motors linked together on one shaft, or by jackshaft.
- G. Actuators shall be installed in such manner to avoid damage to actuator due to condensation.

### 3.7 NETWORK INFRASTRUCTURE INSTALLATION

- A. All network infrastructure components and wiring shall be installed prior to control device installation. For twisted pair networks - install, test, and document test results and physical locations of cabling, conduit, and junction boxes on as-built drawings.
- B. Install and commission all routers, physical layer repeaters, and terminators prior to control device installations. Test routers, etc with the approved network management tool, document results, and identify physical locations of all routers, repeaters, and terminators on as-built drawings.
- C. Install necessary power supplies for infrastructure components and devices prior to device installation. Document the following: power source location indicating panel number and breaker id on the set of as-built drawings, at the source panel, and at each device or infrastructure component.



### 3.8 CONTROL DEVICE INSTALLATION

- A. Coordinate with mechanical and electrical contractors and identify each physical network device location. For retrofit applications physically inspect the site. Document locations on shop drawings and include with submittals provided to architect/engineer and AISD Energy Management department representative.
- B. Provide all isolation, interfacing, and wiring to complete the installation of equipment items that have integral control systems such as packaged air conditioners, heating units and boiler firing systems. Coordinate with manufacturers prior to submitting proposals and again prior to preparing submittals. Provide all components and circuits and interdisciplinary coordination required to interface the controls system for all required status monitoring, operational features, and fire management functions. Completely test and adjust all systems.
- C. Prior to device installation confirm that wiring for all network media, power supply, and I/O has been completed and is available at each location. Notify architect/engineer and/or owners representative immediately of any discrepancies or missing items
- D. Install each network device as physically close as possible to controlled equipment with respect to environmental and electrical noise conditions.

### 3.9 NETWORK DEVICE PROGRAMMING, GRAPHICAL DISPLAYS, STANDARD SETPOINTS, ALARMING AND TREND LOGGING.

- A. All network device programming used to implement control sequences shall be provided to AISD. It shall not be necessary for AISD to further program the system. However, provisions shall be made to allow future modification of the installed control programs.
- B. Provide licensed copies of all software tools, programming aids, and connecting cables, used to install, develop and troubleshoot the controls system to AISD.
- C. Implement the control sequences for the equipment on this project as prescribed in the construction documents and drawing sequence of operation descriptions.
- D. Provide the following Graphic User Interfaces (GUI) as the minimum acceptable but not limited to:
  - 1. Home Page (obtain template from AISD)
  - 2. Time Schedule Page
  - 3. Alarm Console Page
  - 4. Trend Logs Page
  - 5. Summary Page(s)
  - 6. Chilled & Hot Water Call Page (if applicable)
  - 7. Floor Plan(s)
    - a. Provide each floor plan with key plans and dynamically highlight which part of the key plan is in current view.
    - b. Mark location of space sensors to match final installation.
    - c. Provide calibrated space readings (i.e. space temp, CO2, RH, etc)
    - d. Provide quick links (buttons) to associated HVAC equipment graphic pages.
  - 8. Dedicated GUI per each equipment being monitored/controlled by the BAS
    - a. Provide dedicated override points for all outputs.
    - b. Group points as follows:
      - 1) Setpoints: Bottom left-hand side

- 2) Status Points: Bottom center (i.e. space temp, effective setpoints, etc)
  - 3) Overrides: Bottom right-hand side
  - 4) Actual Occupancy: Top center.
  - 5) All Other Points: Overlaid around HVAC schematic
- E. Provide the following minimum cooling and heating setpoints for equipment scheduled to control to maintain space temperature:
1. Base (Cooling) setpoint
  2. Slider Adjust Range [default: -3°F/+3°F]
  3. Setpoint Dead-Band
  4. Effective Cooling Setpoint
  5. Effective Heating Setpoint
  6. Base (Cooling) Setpoint + Slider Adjust Value = Effective Cooling Setpoint
  7. Effective Cooling Setpoint – Dead-Band = Effective Heating Setpoint
  8. Night Setup Setpoint (enable)
  9. Night Setback Setpoint (enable)
  10. Night Setup/Setback Dead-Band
- F. Provide Alarm Extensions to the following points:
1. Freeze-Stat (Change of State Alarm)
  2. Condensate Float Switch (Change of State Alarm)
  3. Low/High Static Pressure Alarm (Change of State Alarm)
  4. Fan Command vs Fan Status (Command Failure Alarm)
  5. Compressor Command vs Compressor Status (Command Failure Alarm)
- G. Provide Trend Logs to the following points:
1. All temperature sensors (Change of Value; Tolerance 1.0F)
  2. All outputs
  3. All status points

### 3.10 LABELS AND IDENTIFICATION

- A. All devices relating to the work or systems included herein, including controllers, valves, relays, etc., shall be identified with a unique identification number or name on the submitted control drawings. This identification number or name, along with the service of the device (discharge air temperature, freeze-stat, etc.), shall be permanently affixed to the respective device.
- B. All field devices shall be supplied with a label indicating its function and point name. Labels shall be “DYMO”-type electronically printed approximately 2-1/2” x 3/4”. Surface shall be cleaned before installing labels. No handwritten labels shall be accepted.
- C. Damper and valve actuators shall be labeled indicating which direction is towards open/bypass position (i.e. CW=BYPASS; CCW=OPEN).
- D. Label ceiling grid where sensors installed above ceiling when applicable.
- E. BAS Panels shall be supplied with a nameplate indicating the equipment being served (i.e. AHU-1 Cafeteria, CO2 Monitoring, etc.). Nameplates shall be engraved on rigid plastic labels approximately 3” x 1”. “DYMO” tape will not be accepted. Only black phenolic with white lettering will be accepted.
- F. All 120 VAC power shall be labeled with source panel and circuit number.

- G. All BAS Junction Boxes covers shall be spray-painted green with “BAS” stenciled over.
- H. All controls wiring, tubing and cabling both inside and outside of control panels shall be labeled at both ends using BRADY PermaSleeve Black on White Wire Marker Sleeves (do not shrink). The wire designations shall match those on the shop and installation drawings. All markings shall be mechanically produced. No handwritten labels shall be accepted.
- I. Communication wiring shall be labeled to specify where is coming from (previous device) and where is going to (next device) at each communication drop (i.e. each controller inside a control panel, each VFD provided with a communication card).

### 3.11 EQUIPMENT PROTECTION AND CLEANING

- A. The BAS system contractor shall provide adequate means for and shall fully protect all finish parts of the materials and equipment against damage during the progress of the work until final acceptance.
- B. Equipment and accessories shall be thoroughly cleaned of cement, plaster, and other materials; grease and oil spots shall be removed with cleaning solvent and surfaces carefully wiped.

### 3.12 AIR BALANCING

- A. The BAS system contractor shall assign an individual full time to assist the air balance technician during the air-balancing process to assure full balance compliance.
- B. The air balance plug-in shall have the ability to globally override local set point values and command all VAV air terminal devices to fully closed, fully open, minimum, and maximum damper positions.
- C. All air balance settings and values shall be documented on the as-built control drawings for future reference.

### 3.13 SUBSTANTIAL PERFORMANCE TEST PROCEDURES

- A. General
  - 1. The work under this section shall undergo a formal Functional Testing Commissioning process as documented in Section 230926c. Contractor shall set aside adequate time for the Commissioning process, including point checkout, sequence verification, and graphics checkout. Contractor shall include adequate time to respond to deficiencies without delaying project completion.
  - 2. Prior to requesting Functional Testing, this Contractor shall have every control point checked end to end to ensure accuracy and integrity of the system.
  - 3. Upon completion of control point end-to-end checkout, Contractor shall submit check-out documentation and DDC O&M Manuals to AISD and Commissioning Authority for review. Refer to Part 1 of this specification for O&M documentation requirements.
  - 4. Upon review and approval of DDC O&M documentation, AISD and Commissioning Authority shall schedule the date for commencement of Functional Testing.
  - 5. Controls Contractor shall make available for the Commissioning process a competent technician who is familiar with the installation and programming of the system.

Contractor's technician shall accompany AISD and Commissioning Authority during Functional Testing.

6. Refer to Section 230926c for detailed description and requirements of the Commissioning process.

B. Documentation

1. Upon successful completion of the Commissioning process, and once all deficiencies identified during Commissioning have been corrected, Contractor shall submit a final As-Built DDC O&M Manual with all programming, control points, network variables, setpoints, and graphics as actually implemented.
2. Provide as-built wiring diagrams showing all device locations, infrastructure component locations, control panels, sensors, actuators, ladder diagrams, for associated hardware interlocks, and sequence of operation descriptions for each subsystem within the network design. Show all interfaces with existing and equipment controls.
3. Provide control panel layout sheets complete with point names, point addresses and wire identification numbers. Attach one copy to each respective panel door.
4. All As-Built (O&M Manuals, etc) documentation, shop drawings, points verification sheets, coordination meeting minutes, etc shall be included in the O&M manuals as well as on a Compact Disc (CD) accompanying the final As-Built.

C. Software Backups & Platform Access

1. Upon successful completion of the Commissioning process, the Contractor shall provide a Platform & Station Backup of the Network Control Unit along with the Credentials to access the NCU Platform.

3.14 PROJECT ACCEPTANCE

- A. Upon receipt and approval of final DDC O&M Controls work shall be considered substantially complete, as recommended by the Commissioning Authority and approved by Owner and Engineer For additional acceptance requirements see Div 230926c.

3.15 POINT LISTS AND SEQUENCES OF OPERATIONS

- A. Refer to drawings.

**END OF SECTION 230926a**

**SECTION 230926c****COMMISSIONING OF BUILDING AUTOMATION SYSTEM (TRIDIUM-BACNET)**

## PART 1 - GENERAL

## 1.0 SCOPE

This specification is Austin Independent School District's Division 230926c Rev. 7/30/2018 and supplements the Commissioning Requirements in Division-1 with specific requirements from Direct Digital Controls (DDC) specified under Division 23. This specification shall be used in its entirety and shall only be modified by, or with permission from AISD-Energy Management Department.

## 1.1 RELATED DOCUMENTS

- A. Division-1, Section 019113 -Commissioning Requirements, addresses responsibilities and procedures for the commissioning process. All requirements of Division-1 specifications apply to this section.
- B. Division-23, Section 230926a -Direct Digital Controls for Local Building Automation Systems (TRIDIUM-BACNET) addresses requirements for design, installation and testing of DDC system using the BACnet protocol for local control of building HVAC systems. All requirements of Section 230926a apply to this section.

## 1.2 RESPONSIBILITIES

- A. Commissioning is the joint responsibility of the Contractor (including subcontractors and vendors) and the Commissioning Authority hired directly by the Owner, the Owner, and the Design Engineer. General assignment of responsibilities during the Commissioning process is specified in Section 019113. All the requirements of Section 019113 apply to this section.
- B. (General) Contractor retains responsibility for coordinating participation of Local Building Automation System subcontractors (Section 230926) throughout the commissioning process, and for ensuring participation by other subcontractors and equipment suppliers, vendors and manufacturers as required to conduct activities specified herein.
- C. Building Automation Systems subcontractor (Division 23) is responsible for assigning representatives with expertise and authority to act on behalf of the subcontractor to conduct commissioning activities specified. Building Automation Systems subcontractors are also responsible for providing tools, software and equipment required to conduct commissioning activities.
- D. Commissioning Authority is responsible for organizing, witnessing and documenting commissioning activities specified.
- E. Owner is responsible for assigning personnel with expertise and authority to act on behalf of the Owner as relates to commissioning of Building Automation Systems, and to provide access to facilities, equipment, and servers as required to conduct commissioning tasks.

- F. Design Engineer is responsible for developing a design that is in compliance with the Owner's Project Requirements and Design Guidelines and for responding to Commissioning Authority's comments.

Design Engineer is also ultimately responsible for the proper operation of the system as designed, regardless of whether or not he chooses to participate in testing and demonstrations.

### 1.3 SUMMARY OF WORK

#### A. DESIGN PHASE (Information Only)

1. Conceptual Design Meeting: Early during Conceptual Design and prior to making firm decisions on the type of HVAC systems and controls to be provided, Design Team shall request a meeting with AISD Service Center personnel and Owner's Commissioning Authority. The main objective of the meeting is to review the Owner's Standard Specifications and Guidelines and ensure design will proceed in accordance.
2. Preliminary Design Submittal: Design Engineer provides complete DDC points list and sequence of operations for all systems at DD design submittal and again at 95% CD design submittal. Sequences and points lists shall be in accordance with Owner's guidelines and standard points lists. Electronic Submittals shall be provided to AISD Service Center personnel and Owner's Commissioning Authority.
3. Design Review Comments: Owner and Commissioning Authority provide comments upon review of DD and 95% CD design submittals. Comments issued in electronic form.
4. Design Review Meeting: A final design review meeting is held upon review of 95% CD's, to verify inclusion of review comments in design. Meeting is attended (at least) by Design Engineer, Owner, and Commissioning Authority. Commissioning Authority provides written documentation of decisions made during meeting.
5. Design Review Follow-up: Commissioning Authority conducts a follow up review of Construction Documents issued for permitting/bids and forwards comments to Owner and Engineer on any outstanding items.

#### B. SUBMITTAL PHASE

1. Preliminary Submittal: Controls subcontractor (Div-23) provides preliminary DDC submittal in accordance with specifications, with digital copies transmitted to AISD Service Center and Owner's Commissioning Authority (ACR). This submittal shall occur shortly after contract award and prior to approval of equipment submittals so that systems may be properly coordinated. In addition to requirements of Section 230926, Building Automation System submittal shall include at least the following:
  - a. Detailed written sequences as they will actually be programmed and using the program variable names;
  - b. Complete point lists including all controlled devices, monitored values, status points, set-points and all variables obtained from BACnet devices including those from equipment provided with BACnet communication cards;

2. Preliminary Submittal Review: Owner and Commissioning Authority issue joint review comments on Preliminary Submittal to Engineer for inclusion with Design Team's review comments to Contractor.
3. Preliminary Submittal Review Meeting: Upon acknowledgement of receipt of Preliminary Submittal review comments, Local Controls subcontractor will request through the Contractor and AISD Project Manager, a review meeting with Owner, Engineer, and Commissioning Authority. Commissioning Authority documents action items resulting from meeting for inclusion in Final Submittal.
4. Final Submittal: Upon addressing comments, Local Controls subcontractor issues Final Submittal for review by Engineer, Owner, and Commissioning Authority.
5. Final Submittal Review Comments: Owner, and Commissioning Authority issue joint comments to Engineer for inclusion with Design Team's final submittal review comments to Contractor.
6. No hardware installation should take place prior to receiving submittals that have been approved by Owner, Engineer and Commissioning Authority.

C. PRE-FUNCTIONAL INSPECTION -Local Building Automation Systems Controls

1. Controls Contractor Request for Pre-Functional Inspection: Upon completion of installation and programming of ALL systems, Controls subcontractor shall issue a written request for Pre-Functional Inspection by Engineer, Owner and Commissioning Authority, certifying that the following work is complete and ready for inspection:
  - a. Manufacturer start-up has been conducted for all equipment requiring it - coordinate with Mechanical Contractor;
  - b. Piping has been flushed and (preliminary) test and balance completed - coordinate with Mechanical Contractor;
  - c. All control and monitoring devices installed, wired and tested;
  - d. Point-to-point check to verify correspondence of control points to control devices verified (provide report);
  - e. All operational sequences tested;
  - f. Control Panel layout sheets complete with point name, point address, and wire identification number (indicating DDC device), with one copy attached to each respective panel door;
  - g. All points and devices permanently tagged with point name, address, and panel number;
  - h. As-Built Controls Diagrams and Sequence Documentation reflecting systems as programmed and installed, to be used during inspection.

2. Pre-Functional Inspection: Contractor shall set aside a minimum of two days to conduct a joint Pre-Functional Inspection of Local Controls Building Automation System work with Engineer, Owner and Commissioning Authority. Work will include the following:
  - a. Physical inspection of installation for compliance with specifications;
  - b. Sample testing of sensors and devices for verification of calibration;
  - c. Sample point-to-point checkout to verify correspondence of commanded points to controlled devices;
  - d. Testing of central plant cooling sequences including plant enable/disable sequences and call for unoccupied operation;
  - e. Testing of central plant heating sequences including plant enable/disable and call for unoccupied operation;
  - f. Testing of air handler units operating sequences (sampling) including occupied/unoccupied sequences and call for unoccupied operation;
  - g. Testing of zone controls (fan-coil, dx-split, vav-boxes) operating sequences (sampling) including occupied/unoccupied sequences and call for unoccupied operation;
3. Pre-Functional Inspection Report: Commissioning Authority prepares a report detailing deficiencies identified during Pre-Functional Inspection and submits to Engineer so he may evaluate and forward to Contractor.
4. Pre-Functional Re-Inspection(s) Request: Upon completion of items on Pre-Functional Inspection Report, Local Controls subcontractor issues a request for Pre-Functional Re-Inspection and the process is repeated.
5. Pre-Functional Acceptance: Upon completion of all items identified during Pre-Functional Inspection, Commissioning Authority issues an official notification of Pre-Functional Acceptance to Engineer so he may forward to Contractor.
6. When deemed advantageous to the project, and depending on system configuration, Pre-Functional Inspection and Functional Testing may be combined into a single activity, at CxA's discretion.

#### D. FUNCTIONAL TESTING

1. Point Check-out Request: Upon completion of controls installation, the Controls Contractor shall submit documentation and issue written notification to Owner, Engineer, and Commissioning Authority stating that the entire system is ready for Point Check-out, including all graphics.
2. Point Check-out & Report: Commissioning Authority shall inspect system via the Web-based Graphic User Interface (GUI) to verify that all specified points are present, that they are reading properly and that they are accessible, commandable and



overridable as specified. Commissioning Authority will issue a point check-out report listing deficiencies to be corrected.

3. Point Check-out Corrections: Controls contractor shall correct deficiencies listed in the Point Check-out Report and issue written notification when system is ready for Functional Testing.
4. Functional Testing: Upon notification by controls contractor that deficiencies in the Point Check-out Report have been corrected, Engineer, Owner, and Commissioning Authority will meet controls contractor at the project site to conduct Functional Testing as described in Part-4 of this specification.
5. Functional Test Report: Upon completion of Functional Testing, Commissioning Authority shall issue a report listing deficiencies to be corrected.
6. Functional Testing Deficiencies Resolution: Controls contractor shall resolve deficiencies in Functional Test Report. Corrections shall be accomplished within a period of no more than 2 weeks. Upon correction of deficiencies, Contractor shall notify Owner and Commissioning Authority when system is ready for Final Functional Testing.
7. Final Functional Test & Report: Upon receiving notification from Contractor, Owner and Commissioning Authority will verify corrections to controls systems. Commissioning Authority will complete a Final Functional Test Report documenting that systems work as per design intent, and/or outlining any recommendations for future improvement.

E. O&M MANUALS AND AS-BUILT DOCUMENTS

1. Requirements for O&M Manuals and As-Built Documentations are included in Section 230926a.
2. Commissioning Authority shall conduct review of O&M's and As-Built's concurrently with Engineer and track documentation.

F. TRAINING

1. Requirements for training of Owner's personnel are included in Section 230926a.
2. Commissioning Authority shall review training material and attend selected training sessions as deemed useful in order to document adequacy.

## PART 2 - PRODUCTS -NOT APPLICABLE

## PART 3 - EXECUTION -NOT APPLICABLE

## PART 4 - FUNCTIONL TESTING PROCEDURES

## 4.0 GENERAL

- A. Seven (7) Day Performance Test: Contractor shall schedule a seven (7) day period to conduct Functional Testing specified herein. Any upset of system operational functionality greater than (2) hours during the seven (7) day test period shall cause the test to be restarted.
- B. Prerequisites for Functional Testing: The following must be complete prior to proceeding with Functional Testing
  - 1. Pre-Functional Testing and Acceptance Notice by Commissioning Authority.
  - 2. End to End Point Checkout by Contractor.
  - 3. Point Checkout Report by Commissioning Authority.
  - 4. Time schedules built and in control of time-controlled equipment.
  - 5. Graphics displays installed and fully operational for each unit, system, and subsystem.
- C. Trending: Implement the following trends prior to initiating testing.
  - 1. Each space sensors shall be placed on a five (5) minute trend for 24 hours to document accurate temperature control of room or zone. Trends shall be recorded electronically for inclusion in Commissioning Report.
  - 2. Each control loop measured variable, controlled variable and setpoint if calculated shall be place on a one (1) minute continuous trend for at least twenty-four (24) hours to document stability of loop. Trends shall be recorded electronically for inclusion in Commissioning Report.
  - 3. Runtime totalizer shall be set on selected digital outputs.
  - 4. Additional variables will be trended at the request of Owner/Commissioning Authority.

## 4.1 FUNCTIONAL TESTING

- A. Local Network Testing (BACnet)
  - 1. The fire alarm system shall be enabled at the time of testing to ensure correct action of all fire and smoke sequences that interface with controls.
  - 2. Network traffic for each device channel shall be measured for 24 hours utilizing a protocol analyzer tool. Channel analysis shall include bandwidth utilization, and error

statistics. Reconfigure nodes and/or install additional routers as necessary to maintain traffic at a no more than 60% of channel bandwidth capacity. Backbone channels that contain permanent HMI's shall consume no more than 30% of total bandwidth capacity.

3. Each network control device, intelligent router, and network interface shall be tested and health verified using the protocol analyzer diagnostics application. Test results shall include neuron error log statistics, self-test results and device state information.
4. A power failure for the building shall be simulated and system recovery monitored. A protocol analyzer log shall record the network traffic for each channel for a 60-minute period following building power restoration.
5. Disable all sending (upstream) devices and simulate connection failures for receiving devices (downstream) that implement fail-safe configuration settings. Verify that downstream devices play failsafe values in the event that network variable updates are not detected by downstream devices within the minimum receive update intervals.
6. Test results shall be printed, recorded electronically and submitted to Owner, Engineer and Commissioning Authority.

B. Functional Testing of Sequences and Controls

1. Functional Checklists: Functional Testing forms shall be developed by Commissioning Authority for each specific system or subsystem to be tested, identifying all control and monitoring points that must be active.
2. End-to-End Verification: Proper operation/response of controlled points shall be verified from the Web-based Graphic User Interface (GUI) front-end to the actual physical devices in the field, as follows:
  - a. Controlled devices shall be commanded to a value at the GUI and its reaction observed in the field.
  - b. Status points shall be changed and observed both in the field and at the GUI.
  - c. Selected sensors shall be tested for accuracy and proper placement to ensure that sensors are properly assigned to the area served.
  - d. Selected points shall be disabled in the field and the proper alarm/response verified at the GUI.
3. Sequence Verifications: Proper operation of programmed sequences shall be verified for each major system type and sampled for multiple identical systems. Sequence verification will include the following as directed by the CxA:
  - a. Response to time schedule commands.
  - b. Response to changes in setpoints.

- c. Responses to changes in field conditions.
- d. Response to loss and restoration of power.
- e. Response to loss and restoration of communication.

**END OF SECTION 230926c**

**SECTION 23 2300**  
**REFRIGERANT PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

**1.2 SUBMITTALS**

- A. Product Data: For refrigerant piping and each type of valve and refrigerant piping specialty indicated.
- B. Operation and maintenance data.

**1.3 QUALITY ASSURANCE**

- A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Refrigerants:
    - a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
    - b. DuPont Company; Fluorochemicals Div.
    - c. Elf Atochem North America, Inc.; Fluorocarbon Div.
    - d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.
  - 2. Refrigerant Valves and Specialties:
    - a. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
    - b. Danfoss Electronics, Inc.
    - c. Emerson Electric Company; Alco Controls Div.
    - d. Henry Valve Company.
    - e. Sporlan Valve Company.

## **2.2 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Bronze Filler Metals: AWS A5.8, Classification [BAg-1 (silver)] [BAg-2 (silver)]

## **2.3 VALVES**

- A. Service Valves: 500-psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.

## **2.4 REFRIGERANT PIPING SPECIALITIES**

- A. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- B. Permanent Filter-Dryer: 350-psig maximum operating pressure and 225 deg F maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

## **2.5 REFRIGERANTS**

- A. ASHRAE 34, R-410A.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. Aboveground, within Building: Type ACR drawn-copper tubing.

### **3.2 SPECIALTY APPLICATIONS**

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

### **3.3 PIPING INSTALLATION**

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23 Section "Common Work Results for HVAC."
- C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Liquid lines may be installed level.
- G. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.
- H. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- I. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
- J. Install hangers with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
- K. Support vertical runs at each floor.

### **3.4 PIPE JOINT CONSTRUCTION**

- A. Braze joints according to Division 23 Section "Common Work Results for HVAC."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

### **3.5 SYSTEM CHARGING**

- A. Charge system using the following procedures:
1. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers.
  2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  3. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

**END OF SECTION**



## **SECTION 23 3113**

### **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. Rectangular ducts and fittings.
  - 2. Round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. 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.

##### **1.3 PERFORMANCE REQUIREMENTS**

- A. 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 62.1-2004.

##### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. 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. Duct layout indicating sizes, configuration, and static-pressure classes.

4. Dimensions of main duct runs from building grid lines.
  5. Fittings.
  6. Sheet metal thicknesses.
  7. Reinforcement and spacing.
  8. Seam and joint construction.
  9. Penetrations through fire, smoke, sound and other partitions.
  10. Equipment installation based on equipment being used on Project.
  11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
  13. Materials, fabrication, assembly, and spacing of hangers and supports.
- C. Welding certificates.

## **1.5 QUALITY ASSURANCE**

- A. 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 D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

## **1.6 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  2. Test the following systems:
    - a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
  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. Give seven days' advance notice for testing.
  7. Schedule one test near the beginning of the ductwork installation to confirm duct sealing methods are acceptable.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports and deliver to the Architect within two days of each test.

## **PART 2 - PRODUCTS**

### **2.1 RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. 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."
- C. 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."
- D. 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 ROUND DUCTS AND FITTINGS**

- A. 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.
  - 1. Manufacturers: Subject to compliance with requirements:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- B. 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."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."

- D. 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 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: G90.
  - 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.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### 2.4 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.
- 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.

- 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.

## **2.5 HANGERS AND SUPPORTS**

- A. Hanger Rods: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- B. All metal components of ductwork system such as angle stiff shall be galvanized
- C. Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Rods for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Duct Attachment for exposed double wall ducts shall be a single point connection concealed at the top of the duct to minimize visibility. Duct to be support by stainless steel air craft cable. Provide 45 degree lateral supports as required to stabilize each run.
- G. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## **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. Install ducts with fewest possible joints.

- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. 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.
- J. 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.
- K. 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."

### **3.2 INSTALLATION 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.
- 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.

### **3.3 ADDITIONAL INSTALLATION 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 12 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.

### **3.4 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."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
  - 4. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 5. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 6. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 8. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 9. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 10. Conditioned Space, Return-Air Ducts: Seal Class C.
- C. Seal Ductwork exposed to view with materials that match the ductwork finish or provide matching ductwork material to conceal the exposed seals and provide a continuous finish look on the system.

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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: stainless steel air craft cable.

- 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 intervals 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.

### **3.6 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.

### **3.7 DUCT CLEANING**

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, condensate drain pans, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.

### **3.8 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.



### 3.9 DUCT SCHEDULE

- A. Fabricate ducts as follows:
1. Concealed Supply Ducts
    - a. Paint Grip Galvanized Steel
    - b. Positive 4-inch wg.
  2. Exposed Supply Ducts
    - a. Paint Grip Galvanized Steel
    - b. Positive 4-inch wg.
  3. Concealed Return Ducts
    - a. Paint Grip Galvanized Steel
    - b. Positive or negative 2-inch wg.
  4. Exposed Return Ducts
    - a. Paint Grip Galvanized Steel
    - b. Positive or negative 2-inch wg.
  5. Exhaust Ducts
    - a. Paint Grip Galvanized Steel
    - b. Negative wg 2-inch wg.
  6. Lab Exhaust Ducts
    - a. Stainless Steel
    - b. Negative wg 2-inch wg.
  7. Outdoor-Air Ducts
    - a. Galvanized Steel
    - b. Positive or negative 3-inch wg.
- B. 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.
- C. Branch Configuration:
1. Rectangular Duct: All branch connections shall be 45-degree entry. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."
    - a. Conical tap.

**END OF SECTION**

**SECTION 23 5416**  
**GAS-FIRED FURNACES**

**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. Gas-fired, furnaces and accessories suitable for exterior installation.
  - 2. Air filters.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Include diagrams for power, signal, and control wiring.
- C. Sample Warranty: For special warranty.
- D. Operation and Maintenance Data: For each furnace to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Furnace and accessories complete with controls.
    - b. Air filter.
    - c. Air cleaner.
    - d. UV germicidal light.
    - e. Humidifier.
    - f. Ventilation heat exchanger.
    - g. Refrigeration components.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Disposable Air Filters: Furnish two complete sets.
  - 2. Fan Belts: Furnish one set for each furnace fan.

## **1.5 QUALITY ASSURANCE**

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. Comply with NFPA 70.

## **1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:
  - 1. Warranty Period, Commencing on Date of Substantial Completion:
    - a. Furnace Heat Exchanger: 10 years.
    - b. Integrated Ignition and Blower Control Circuit Board: Five years.

## **PART 2 - PRODUCTS**

### **2.1 ASSEMBLY DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended location and application.
- B. General Requirements for Noncondensing Gas-Fired Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.

### **2.2 GAS-FIRED FURNACES**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Carrier Air Conditioning; Div. of Carrier Corporation.
  - 2. Daikin
  - 3. Trane Company (The); Unitary Products Group (Basis of Design)
  - 4. Lennox.
- B. Cabinet: Aluminum or stainless steel
  - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
  - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
  - 3. Factory paint external cabinets in manufacturer's standard color.
  - 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Fan: Centrifugal, factory balanced, resilient mounted, belt drive.
  - 1. Fan Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Special Motor Features: Single speed, premium efficiency, as defined in Section 230513 "Common Motor Requirements for HVAC Equipment," and with internal thermal protection and permanent lubrication.

3. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
  4. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- D. Type of Gas: Natural.
- E. Heat Exchanger: Stainless steel direct fired
- F. Burner:
1. Gas Valve: 100 percent safety modulating main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
  2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- G. Gas-Burner Safety Controls:
1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
  2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
  3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- H. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; and adjustable fan-on and fan-off timing; terminals for connection to accessories.
- I. Capacities and Characteristics:
1. Airflow Configuration: Horizontal.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Base and Roof -Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
  1. Anchor furnace to substrate to resist code-required seismic acceleration.
- C. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.

- D. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.
- E. Gas piping installation requirements are specified in Section 231123 "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- F. Install piping adjacent to equipment to allow service and maintenance.
- G. Vent Connection, Noncondensing, Gas-Fired Furnaces: Connect Type B vents to furnace vent connection and extend outdoors. Type B vents and their installation requirements are specified in Section 235123 "Gas Vents."
- H. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."
- I. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled compressor-condenser unit.
  - 1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."
  - 2. 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.
  - 3. 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/A5.8M.
- J. Comply with requirements in Section 232300 "Refrigerant Piping" for installation and joint construction of refrigerant piping.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Perform electrical test and visual and mechanical inspection.
  - 2. Leak Test: After installation, charge systems with refrigerant and test for leaks. Repair leaks, replace lost refrigerant, and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
  - 4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
  - 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

### **3.4 STARTUP SERVICE**

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  1. Inspect for physical damage to unit casings.
  2. Verify that access doors move freely and are weathertight.
  3. Clean units and inspect for construction debris.
  4. Verify that all bolts and screws are tight.
  5. Adjust vibration isolation and flexible connections.
  6. Verify that controls are connected and operational.
- B. Adjust fan belts to proper alignment and tension.
- C. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- D. Measure and record airflows.
- E. Verify proper operation of capacity control device.
- F. After startup and performance test, lubricate bearings and adjust belt tension.

### **3.5 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

### **3.6 CLEANING**

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

### **3.7 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Section 017900 "Demonstration and Training."

**END OF SECTION**

## SECTION 23 8127

### SPLIT SYSTEM AIR CONDITIONERS

#### 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. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. This Section includes split-system air-conditioning heat pump units consisting of separate evaporator-fan and compressor-condenser components.

##### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

##### 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Startup: Startup must be done by manufacturer's technical representative who will provide written certification that installation meets manufacturer's requirements
- C. 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.
- 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 90.14, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## **1.5 COORDINATION**

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases.
- B. Coordinate size, location, and connection details with equipment supports, and wall penetrations.

## **1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components and provide required labor services of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## **1.7 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set of filters for each unit.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carrier Air Conditioning; Div. of Carrier Corporation.
  - 2. Daikin
  - 3. Trane Company (The); Unitary Products Group (Basis of Design)
  - 4. Lennox.

### **2.2 EVAPORATOR-FAN COMPONENTS**

- A. Cabinet: Enameled steel with removable panels on front and ends in manufacture standard color.
  - 1. Insulation: Faced, glass-fiber, duct liner.
  - 2. Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
  - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.



- C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
- D. Fan: Direct drive, centrifugal.
  - 1. Fan Motors:
    - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
- E. Filters: ASHRAE 52.2 MERV rating of 13 unless Owner approves less.

### **2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS**

- A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - 1. Compressor Type: Scroll.
  - 2. Refrigerant: Non HCFC.
  - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- C. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits operation down to 45 deg F.
- G. Mounting Base: Structural Steel.
- H. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."

### **2.4 ACCESSORIES**

- A. Equipment operating sequences are specified on the drawings and in division 23specification.
- B. Control Module: Unit-mounted digital panel with touchpad temperature control and touchpad for heating, cooling, and fan operation. Include the following features:
  - 1. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F outdoor air temperature.

- C. Thermostat: Low voltage with subbase to control compressor and evaporator fan with the following features:
  - 1. Fully Programmable to time of day and day of the week
  - 2. Compressor time delay.
  - 3. 24-hour time control of system stop and start.
  - 4. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  - 5. Fan-speed selection, including auto setting.
- D. Automatic-reset timer to prevent rapid cycling of compressor.
- E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
  - 1. Minimum Insulation Thickness: 1 inch thick.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounting, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Coordinate anchor installation with concrete base.
- D. Install ground-mounting, compressor-condenser components on polyethylene mounting base.
- E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch.
- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

#### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

- E. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### **3.4 STARTUP SERVICE**

- A. Engage a manufacturer's technical representative to perform startup service. Provide written certification that installation meets manufacturer's requirements.
  - 1. Complete installation and startup checks according to manufacturer's written instructions. Provide written certification that installation meets manufacturer's requirements.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION**

## SECTION 260100 – COMMISSIONING OF ELECTRICAL 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. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section 016500 – “GENERAL COMMISSIONING REQUIREMENTS” for general commissioning process requirements.
  - 2. Division 23 Section 230100 - “COMMISSIONING OF MECHANICAL SYSTEMS”.

**1.3 DEFINITIONS**

- A. Commissioning Authority (CxA): Independent agent hired by Owner and not associated with General Contractor or its subcontractors, Architect or its sub-consultants, or Construction Administrator or its staff or consultants. Under Owner’s direction, and not General Contractor’s direction, CA will direct and coordinate day-to-day commissioning activities without assuming oversight responsibilities.
- B. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.

**1.4 CONTRACTOR’S RESPONSIBILITIES**

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Perform commissioning tests at the direction of the CxA.**
- C. Attend construction phase controls coordination meeting.
- D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.

- F. Complete project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- G. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.
- H. Provide test data, inspection reports, and certificates for Systems Manual.

## **1.5 COMMISSIONING DOCUMENTATION**

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
  - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
  - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
  - 3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
  - 4. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
  - 5. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.

## **1.6 SUBMITTALS**

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Refer to section 016500 - GENERAL COMMISSIONING REQUIREMENTS.

### **3.2 PRE-FUNCTIONAL CHECKLISTS**

- A. Contractor shall conduct Pre-functional Testing to document compliance with installation and start-up checklists prepared by Commissioning Authority for the Division-26 items.

- B. Request verification of Pre-functional checklists by CxA prior to proceeding with system start-up and Functional Testing of systems.
- C. Contractor shall participate in Pre-Functional testing activities to document electrical work associated with mechanical and plumbing systems.
- D. Refer to Section 016500 - GENERAL COMMISSIONING REQUIREMENTS for issues relating to pre-functional checklists and testing, including list of systems to be commissioned, description of process, details on non-conformance issues relating to pre-functional checklists and test.

### **3.3 SYSTEM START-UP, TESTS & INSPECTIONS**

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until General Contractor has completed start-up and resolved all operating deficiencies.
- B. Contractor is solely responsible for all tests and inspections required by the Authority Having Jurisdiction (AHJ). All test reports and certificates required by the AHJ shall be submitted prior to Functional Testing.
- C. Contractor shall provide no less than 48 hours notice prior to conducting tests specified in other sections of the specifications, including:
  - 1. Grounding tests

### **3.4 FUNCTIONAL TESTING PREPARATION**

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check all notification and initiation devices and interlocks with associated systems during each mode of operation.
- F. Testing Instrumentation: Provide instrumentation and personnel as required to conduct tests.

### **3.5 FUNCTIONAL TESTING PROCEDURES OF SYSTEMS TO BE COMMISSIONED**

- A. All Electrical and Electrically Powered Equipment
1. Inspect electrical wiring and grounding for proper connections, color coding, and quality of installation.
  2. Verify supply voltage, all hot legs.
  3. Verify amperage is within allowable limits.
  4. Inspect for physical damage, proper installation, anchorage.
  5. Verify equipment runs smoothly and quietly.
  6. Verify operation of safeties.
  7. Verify all required means of disconnect are in place.
  8. Verify maintenance and NEC clearances are maintained.
- B. Service Grounding Test:
1. CxA will witness ground tests to be conducted by Contractor in accordance with specifications. Contractor will provide CxA a minimum 48 hours advance notice of test so that CxA may be witness, or he shall re-test in CxA's presence. Ground resistance testing is to include lightning protection system as well as electrical power systems.
  2. Provide ground test report for review by CxA.
- C. Electrical Distribution System
1. Switchboards and Panelboards.
    - a. Wiring:
      - 1) Verify wiring connections are secure.
      - 2) Verify ground wires properly terminated, panels are grounded.
      - 3) Verify wiring color coding is proper.
    - b. Verify panel is properly identified.
    - c. Verify load indicated in circuit directory is actual load served in space (by opening circuit breaker and observing response in space).
    - d. Verify load identification is adequately descriptive of load.
    - e. Verify phase rotation
    - f. Verify phase to phase and phase to neutral volts.
    - g. Document phase balance.

### **3.6 TRAINING**

- A. Refer to sections 016500 - GENERAL COMMISSIONING REQUIREMENTS.

### **3.7 O&M MANUALS**

- A. Refer to sections 016500 - GENERAL COMMISSIONING REQUIREMENTS and section 017800 CLOSEOUT SUBMITTALS.

**END OF SECTION**

## SECTION 26 0519

### 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.
- B. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Sections include the following:
  - 1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
  - 2. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

##### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. 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.



- C. Comply with NFPA 70.

## **PART 2 - PRODUCTS**

### **2.1 CONDUCTORS AND CABLES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Aluminum Conductors: Distribution feeder conductors in sizes 4/0 to 1000 kcmil may be aluminum alloy. Aluminum alloy conductors shall be compact stranded conductors of STABILOY® (AA-8030) as manufactured by Alcan Cable or of a recognized 8000 Series aluminum alloy conductor material by the Aluminum Association.
- D. Conductor Insulation: Copper, Comply with NEMA WC 70 for Types THW THHN-THWN XHHW XHHW-2 and SO.
- E. Conductor Insulation: Aluminum, for use in raceways: Sizes #4/0 to 1000 kcmil, Type XHHW-2, temperature rating 90° C and marked "SUN RES". For use in Cable Trays: Sizes # 4/0 AWG and larger Type XHHW-2, temperature rating 90° C and marked: "SUN RES", "VW-1", "GASOLINE AND OIL-RESISTANT II", and "FOR CT USE".
- F. Multiconductor Cable: The use of spiral wound insulated conductors, commonly known as BX, MC or AC cable, will not be allowed without specific approval from AISD.

### **2.2 CONNECTORS AND SPLICES**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Aluminum Requirements:
  - 1. Using Mechanical Screw Type Connectors:
    - a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified.
    - b. Using a suitable stripping tool, to avoid damage to the conductor, remove insulation from the required length of the conductor.

- c. Clean the conductor surface using a wire brush and apply a Listed joint compound.
  - d. Tighten the connection per the connector manufacturer's recommendation.
  - e. Wipe off any excess joint compound.
2. Using Mechanical Compression Type Connectors:
- a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified.
  - b. The lugs shall be marked with wire size, die index, number and location of crimps and shall be suitably color coded. Lug barrel shall be factory prefilled with a joint compound Listed by UL.
  - c. Using a suitable stripping tool, to avoid damage to the conductor, remove insulation from the required length of the conductor.
  - d. Clean conductor surface using a wire brush.
  - e. Crimp the connection per the connector manufacturer's recommendation.
  - f. Wipe off any excess joint compound.
3. Termination of Aluminum Conductor to Aluminum Bus:
- a. Prepare a mechanical connection conforming to 1 or 2.
  - b. Hardware:
    - 1. Bolts: Anodized aluminum alloy 2024-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
    - 2. Nuts: Aluminum alloys 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
    - 3. Washers: Flat aluminum alloy 2024-T4, Type "A" plain, standard wide series conforming to ANSI B27.2.
    - 4. Lubricate and tighten the hardware as per the manufacturer's recommendations.
4. Termination of Aluminum Conductor to Copper Bus:
- a. Prepare a mechanical connection conforming to 1 or 2.
  - b. Hardware:
    - 1. Bolts: Plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to ASTM A-325 or SAE grade 5.
    - 2. Nuts: Heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B.
    - 3. Washers: Should be of steel; Type A plain standard wide series conforming to ANSI B27.2.
    - 4. Belleville conical spring washers: Shall be of hardened steel, cadmium plated or silicone bronze.
    - 5. Lubricate and tighten the hardware as per the manufacturer's recommendations.
5. Termination of Aluminum Conductor to Equipment Not Equipped for Termination of Aluminum Conductor.
- a. Prepare compression connection using an adapter Listed by UL for the purpose or by pigtailling a short length of suitable size of copper conductor to the aluminum conductor with a compression connector Listed by UL.
  - b. Provide an insulating cover over adapter body or the compression connector.
  - c. Terminate the adapter or the pigtail on to the equipment per manufacturer's recommendation.

## **PART 3 - EXECUTION**

### **3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper. Stranded for all gauges. Do not use wire smaller than No. 12 AWG, except for signal or control circuits.
- B. Branch Circuits: Copper. Stranded for all gauges. Do not use wire smaller than No. 12 AWG, except for signal or control circuits.
- C. Conductors larger than 2/0 may be 8000 Series aluminum alloy.

### **3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- D. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway.
- H. Parking Lot Lights: Type XHHW-2, with durable insulation resistant to moisture, insects, and physical damage, single conductors in raceway.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- D. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### **3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.6 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### **3.7 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

- C. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
  
- D. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION**

## SECTION 26 0526

### GROUNDING AND BONDING 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.
- B. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. Section includes grounding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

#### PART 2 - PRODUCTS

##### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

## **2.2 CONNECTORS**

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## **2.3 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

## **PART 3 - EXECUTION**

### **3.1 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- D. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.

### **3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### **3.3 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
  - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- C. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### **3.4 INSTALLATION**

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.



- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- G. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

### **3.5 LABELING**

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
  - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.

- D. Tests and Inspections:
1. Provide proposed methodology for each specified for approval prior to conducting actual tests. Proceed with tests upon approval of methodology by Engineer and City of Austin.
  2. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  3. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  4. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  5. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports with copy to the Owner.
- G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  2. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

## SECTION 26 0529

### HANGERS AND SUPPORTS 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.
- B. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

##### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.

##### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.

- 3) Hilti Inc.
- 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
- 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
- 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
- 6. Toggle Bolts: All-steel springhead type.
- 7. Hanger Rods: Threaded steel.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

5. To Light Steel: Sheet metal screws.
  6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
  - F. Hangers cannot be supported from other piping, ducts, or joist bridging. Verify with structural whether or not hangers can be supported from metal deck.

### **3.3 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.4 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

## SECTION 26 0533

### RACEWAYS 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.
- B. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Metal wireways and auxiliary gutters.
  - 3. Boxes, enclosures, and cabinets.
  - 4. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
  - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
  - 2. Division 27 Section "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
  - 3. Division 28 Section "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

##### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
  - 7. Republic Conduit.
  - 8. Robroy Industries.
  - 9. Southwire Company.
  - 10. Thomas & Betts Corporation.
  - 11. Western Tube and Conduit Corporation.
  - 12. Wheatland Tube Company; a division of John Maneely Company.
  
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  
- C. IMC: Comply with ANSI C80.6 and UL 1242.
  
- D. EMT: Comply with ANSI C80.3 and UL 797.
  
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew or compression.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  
- F. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

### **2.2 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
  
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R Type 4 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type Screw-cover type Flanged-and-gasketed type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

### **2.3 BOXES, ENCLOSURES, AND CABINETS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a Pentair company.
  - 7. Hubbell Incorporated; Killark Division.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney; a brand of EGS Electrical Group.
  - 12. RACO; a Hubbell Company.
  - 13. Robroy Industries.
  - 14. Spring City Electrical Manufacturing Company.
  - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  - 16. Thomas & Betts Corporation.
  - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Metal Floor Boxes:
  - 1. Material: Cast metal or sheet metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R Type 4 Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
  - 1. NEMA 250, Type 1 Type 3R Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis.
    - e. Oldcastle Precast, Inc.; Christy Concrete Products.
    - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering, "ELECTRIC."
  - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  - 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete fiberglass.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis.

- e. Nordic Fiberglass, Inc.
- f. Oldcastle Precast, Inc.; Christy Concrete Products.
- g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
- 2. Standard: Comply with SCTE 77.
- 3. Color of Frame and Cover: Green.
- 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
- 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 7. Cover Legend: Molded lettering, "ELECTRIC."
- 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

### **PART 3 - EXECUTION**

#### **3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.
  - 2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment).
  - 3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations with lengths not less than 3-feet nor more than 6-feet.
  - 4. Damp or Wet Locations: IMC.
  - 5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
  - 6. Exposed, Subject to Physical Damage: RS
- C. Minimum Raceway Size: 3/4-inch trade size for lighting and 3/4-inch trade size for power.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, fittings. Comply with NEMA FB 2.10.
  - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. General: All conduits shall be run straight and parallel to construction lines. Conduit shall be supported "independently" to building structure. Emergency, security, telephone, fire alarm, power, lighting, control, fiber optic cable, BEMS, data wiring, and clean power systems shall be run in separate conduits.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- I. A. Support conduit within 12 inches of enclosures to which attached.
- J. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to RNC, Type EPC-40-PVC, before rising above floor.
- K. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.00078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- GG. Any conduit on roof must have at least 12-inches of clearance between conduit and roof surface as noted in AISD Roofing Standards.
- HH. The use of spiral wound insulated conductors, commonly known as BX or MC cable, shall not be allowed without specific approval of AISD.

### **3.3 INSTALLATION OF UNDERGROUND CONDUIT**

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
  2. Install backfill as specified in Division 31 Section "Earth Moving."
  3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

### **3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### **3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.6 FIRESTOPPING**

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### **3.7 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**



## SECTION 26 0544

### SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

#### 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. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel Plastic Stainless steel.
  - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Presealed Systems.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **2.5 SILICONE SEALANTS**

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches Insert dimension above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.3 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

**END OF SECTION**

## SECTION 26 0553

### 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.
- B. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

##### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

## 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- G. Write-On Tags: Polyester tag, 0.010 inch thick with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## **2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

## **2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.010 inch thick with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## **2.4 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, 0.010 inch thick with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## **2.5 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Tag: Type I:
  - 1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - 2. Thickness: 4 mils.
  - 3. Weight: 18.5 lb/1000 sq. ft.
  - 4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

## **2.6 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches.



- D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## 2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

## 2.9 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black.

- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

## **2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
  - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Red.
      - 2) Phase B: Black.
      - 3) Phase C: Blue.
    - c. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Yellow.
      - 3) Phase C: Purple.
    - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels Baked-enamel warning signs.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- F. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Adhesive film label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Enclosed circuit breakers.
    - e. Push-button stations.
    - f. Contactors.
    - g. Remote-controlled switches, dimmer modules, and control devices.

**END OF SECTION**

## SECTION 26 0573

### OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

#### 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 computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
  - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

##### 1.3 ACTION SUBMITTALS

- A. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form. Provide proposed methodology for approval prior to conducting actual study. Proceed with study upon approval of methodology by Engineer and City of Austin.
  - 1. Study and Equipment Evaluation Reports.
  - 2. Coordination-Study Report.

##### 1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

## **PART 2 - PRODUCTS**

### **2.1 COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### **3.2 POWER SYSTEM DATA**

- A. Gather and tabulate the following input data to support coordination study:
  - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Impedance of utility service entrance.
  - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
    - a. Circuit-breaker and fuse-current ratings and types.
    - b. Relays and associated power and current transformer ratings and ratios.
    - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    - d. Generator kilovolt amperes, size, voltage, and source impedance.
    - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    - f. Busway ampacity and impedance.
    - g. Motor horsepower and code letter designation according to NEMA MG 1.
  - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

### 3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
  - 1. Switchgear and switchboard bus.
  - 2. Medium-voltage controller.
  - 3. Motor-control center.
  - 4. Distribution panelboard.
  - 5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 IEEE 241 and IEEE 242.
  - 1. Transformers:
    - a. ANSI C57.12.10.
    - b. ANSI C57.12.22.
    - c. ANSI C57.12.40.
    - d. IEEE C57.12.00.
    - e. IEEE C57.96.
  - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
  - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
  - 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
  - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
  - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

- F. Equipment Evaluation Report:
  - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
  - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

### 3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
  - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
  - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
  - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 IEEE 241 IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
  - 1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
  - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
    - a. Device tag.
    - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
    - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
    - d. Fuse-current rating and type.
    - e. Ground-fault relay-pickup and time-delay settings.



2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
    - a. Device tag.
    - b. Voltage and current ratio for curves.
    - c. Three-phase and single-phase damage points for each transformer.
    - d. No damage, melting, and clearing curves for fuses.
    - e. Cable damage curves.
    - f. Transformer inrush points.
    - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

**END OF SECTION**

## SECTION 26 0575

### ARC FLASH HAZARD ANALYSIS STUDY

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Division 260573 Overcurrent Protective Device Coordination Study.

##### 1.2 SUMMARY

- A. This Section includes, once the data has been collected, a short circuit analysis followed by a coordination study should be performed. The resultant data can then be fed into the equations described by either NFPA 70E-2000 or IEEE Standard 1584-2002. These equations will produce the necessary flash protection boundary distances and incident energy to determine the minimum PPE requirement. Protective devices shall be set based on results of the protective device coordination study.
  - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

##### 1.3 ACTION SUBMITTALS

- A. Other Action Submittals: The following submittals shall be made after the approval process of methodology has been completed. Submittals may be in digital form. Provide proposed methodology for approval prior to conducting actual study. Proceed with study upon approval of methodology by Engineer and City of Austin.
  - 1. Arc Flash Hazard Study.
  - 2. Personal Protective Equipment (PPE) recommendations based on the Study.

##### 1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Manual calculations are not acceptable.
- B. Comply with NFPA 70E for approved equations and procedures.
- C. Comply with IEEE 1584 for approved equations and procedures.

##### 1.5 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
  - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
  - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
  - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in industrial and Commercial Power Systems.
  6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
  2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
  3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS SKM SYSTEMS ANALYSIS, INC. www.skm.com SECTION 12345, Copyright ©2007 SKM Systems Analysis, Inc. 12345-3 DATE
  4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
1. NFPA 70 - National Electrical Code, latest edition
  2. NFPA 70E – Standard for Electrical Safety in the Workplace

## **PART 2 - PRODUCTS**

### **2.1 COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

- A. Comply with NFPA 70E and IEEE 1584.

## **PART 3 - EXECUTION**

### **3.1 ARC FLASH WARNING LABELS**

- A. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
1. Location designation
  2. Nominal voltage
  3. Flash protection boundary
  4. Hazard risk category
  5. Incident energy
  6. Working distance
  7. Engineering report number, revision number and issue date.
- D. Labels shall be machine printed, with no field markings.

- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
  - 1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
  - 2. For each motor control center, one arc flash label shall be provided.
  - 3. For each low voltage switchboard, one arc flash label shall be provided.
  - 4. For each switchgear, one flash label shall be provided.
  - 5. For medium voltage switches one arc flash label shall be provided
- F. Labels shall be field installed.

### **3.2 TRAINING**

- A. The contractor of the arc flash study shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized
- B. The contractor of the arc flash study shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours).

**END OF SECTION**

## **SECTION 26 2416**

### **PANELBOARDS**

#### **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. Reference AISD's standards section 011913 for project commissioning Requirements.

##### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

##### **1.3 DEFINITIONS**

- A. SVR: Suppressed voltage rating.

##### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

##### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards 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.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.

## **1.8 COORDINATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR PANELBOARDS**

- A. Enclosures: Surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 3. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
  1. Material: **Hard-drawn copper, 98 percent conductivity.**
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Compression type.
  3. Ground Lugs and Bus-Configured Terminators: Compression type.
  4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. Square D; a brand of Schneider Electric.
  3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers;
- G. Branch Overcurrent Protective Devices: Fused switches.

## **2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. Square D; a brand of Schneider Electric.
  - 3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

## **2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. Siemens Energy & Automation, Inc.
  - 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.

## **2.5 PANELBOARD SUPPRESSORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Current Technology; a subsidiary of Danahar Corporation.
  - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 4. Liebert Corporation.
  - 5. Siemens Energy & Automation, Inc.
  - 6. Square D; a brand of Schneider Electric.
- B. Surge Protection Device: See Division 264313 for requirements.



## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- I. Comply with NECA 1.

### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- F. Panelboards will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.4 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges **[as indicated] [as specified in Section 260573.16 "Overcurrent Protective Device Coordination Study."]**
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### **3.6 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 26 2726

### 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.
- B. Reference AISD's standards section 011913 for project commissioning Requirements.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Weather-resistant receptacles.
  - 3. Snap switches and wall-box dimmers.
  - 4. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

##### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

##### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

### **2.2 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

### **2.3 STRAIGHT-BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Cooper; 5351 (single), CR5362 (duplex).
    - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5361 (single), 5362 (duplex).

### **2.4 GFCI RECEPTACLES**

- A. General Description:
  - 1. Straight blade, non-feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Cooper; VGF20.
    - b. Hubbell; GFR5352L.
    - c. Pass & Seymour; 2095.
    - d. Leviton; 7590.

## 2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Single Pole:
      - 1) Cooper; AH1221.
      - 2) Hubbell; HBL1221.
      - 3) Leviton; 1221-2.
      - 4) Pass & Seymour; CSB20AC1.
    - b. Three Way:
      - 1) Cooper; AH1223.
      - 2) Hubbell; HBL1223.
      - 3) Leviton; 1223-2.
      - 4) Pass & Seymour; CSB20AC3.
    - c. Four Way:
      - 1) Cooper; AH1224.
      - 2) Hubbell; HBL1224.
      - 3) Leviton; 1224-2.
      - 4) Pass & Seymour; CSB20AC4.
- C. Keyed Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Single Pole:
      - 1) Leviton; 1221-2IL.
    - b. Three Way:
      - 1) Leviton; 1103-2L.

## 2.6 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
  - 1. 600 W; dimmers shall require no derating when ganged with other devices.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.8 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Isolated-Ground Receptacles: Orange.
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

- D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  8. Tighten unused terminal screws on the device.
  9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
  2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.



### **3.2 GFCI RECEPTACLES**

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### **3.3 IDENTIFICATION**

- A. Comply with Division 26 Section "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

**END OF SECTION**