



Request for Competitive Sealed Proposals 19CSP070 Renovations at O’Henry Middle School

Date	Event
November 6, 2018 November 13, 2018	Advertise/Issue Date
November 13, 2018	Pre-Proposal Conference at 10: 00 AM O’Henry Middle School 2610 West 10th Street Austin, Texas 78703
November 19, 2018	Due Date for Questions by 5:00 pm
November 28, 2018	Questions and Answers posted on our website
December 6, 2018	CSP opening / due date at 2:00 pm CST
January 28, 2019	AISD Board Meeting for review/approval

Deliver Sealed Proposals to:

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

Contact:

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

- Questions must be submitted via e-mail to the contact person listed above.
In the e-mail subject line, type: *Questions 19CSP070- Renovations at O’Henry Middle School*
- Q & A and Addenda will be posted on our website: 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:**
 - Required**
 - One (1) hard copy marked “original” – include signed “required” forms
 - Requested**
 - 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.**

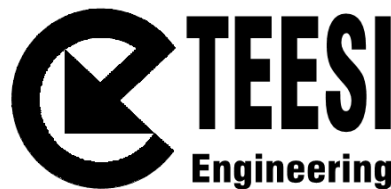
AUSTIN INDEPENDENT SCHOOL DISTRICT

RENOVATIONS AT O'HENRY MIDDLE SCHOOL

PROJECT NUMBER: 19-0040-OHNRV

AISD Construction Management Dept.
812 San Antonio, Suite #200
Austin, Texas 78701

OCTOBER 2018



1301 S. Capital of Texas Highway,
Capital View Center, Suite B-325, Austin, Texas 78746
(512) 328-2533

WWW.TEESI.COM

DIVISION 00

**BIDDING AND CONTRACT
REQUIREMENTS**

DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS
(FRONT END DOCUMENTS) TABLE OF CONTENTS

CHECKLIST AND SUBMISSION GUIDELINES..... 2
PROJECT MANUAL TABLE OF CONTENTS..... 3
REQUEST FOR PROPOSALS 9
PROPOSAL FORM.....15
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION34
PROPOSAL/BID BOND122
SELF-PERFORMANCE EXPLANATION / JUSTIFICATION124
FELONY CONVICTION NOTICE FORM.....126
SUSPENSION AND DEBARMENT CERTIFICATION.....129
AGREEMENT FOR CONSTRUCTION CONTRACT.....131
NOTICE OF PREVAILING WAGE RATES.....138
AVISO DE TARIFAS SALARIALES VIGENTES.....139
NOTICE OF PROVIDER OF WORKFORCE SCREENING SERVICES.....142
CERTIFICATE OF INSURANCE144
PAYMENT BOND147
PERFORMANCE BOND.....150
NOTICE OF REQUIRED WORKERS’ COMPENSATION COVERAGE152
AISD SCHOOL SAFETY RULES.....154
REGLAS ESCOLARES DE SEGURIDAD DE AUSTIN ISD155
CONTRACTOR INSTRUCTIONS FOR ISSUANCE OF KEYS AND ACCESS.....156
ESTIMATE FOR PARTIAL PAYMENT.....160
INTERIM CHANGE AUTHORIZATION162
CHANGE ORDER.....164
TIME EXTENSION REQUEST.....168
CERTIFICATION OF PROJECT COMPLIANCE170
CERTIFICATE OF SATISFACTION OF BILLS173
CONTRACTOR CERTIFICATION.....175
FIRST TIER SUBCONTRACTOR CERTIFICATION179
SUB-SUBCONTRACTOR CERTIFICATION183

CHECKLIST AND SUBMISSION GUIDELINES

Check when Completed	Task to be Completed by Respondent
	Request for Proposal Form (information typed in and signed)
	Proposal Guaranty
	Felony Conviction Notice
	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
	Hard Copy Submission AISD requires one (1) marked “original” and three (3) marked
	Electronic Copy: 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
6	Table C – All Non-School projects completed in the past 8 years
7	Table D – Personnel
8	Proposal Guaranty
9	Felony Conviction Notice
11	Required HUB Documentation

AISD Project No. 19-0040-OHNRV

PROJECT MANUAL TABLE OF CONTENTS

1. Project Title: Renovations at O'Henry Middle School

2. Description of Work:

- a. Upgrade of central plant equipment and controls.
- b. Upgrade of 500-wing water source heat pumps and controls.
- c. Replacement of various electrical distribution equipment.
- d. Upgrade of site lighting.
- e. Replacement of Kitchen sanitary waste and vent piping plus upgrade of domestic hot water heaters.
- f. Replacement of gymnasium shower mixing valves.

3. Architect/Engineer:

Saleem Khan, P.E., CxA

TEESI Engineering
1301 S. Capital of Texas HWY, B-325
Austin, Texas 78746
Phone: (512) 328-2533 x208

Mitch Bible, P.E.

TEESI Engineering
1301 S. Capital of Texas HWY, B-325
Austin, Texas 78746
Phone: (512) 328-2533 x202

4. Consultants:

Structural Engineer:

Douglas J Rothermel, PE, MLSE, LEED® AP

JQ Engineering
108 Wild Basin Road, Suite 350
Austin, Texas 78746
Phone: (512) 474-9094

Roofing Consultant:

Jennifer Doyle, P.E., RRC, LEED AP

Engineered Exteriors, PLLC
13740 Research Blvd., Suite C2
Austin, Texas 78750
Phone: (512) 571-3530

5. Drawings: The Drawings are as follows, and are dated October 2018 unless a different date is shown below.

Drawing List:

- C0.0 COVER SHEET
- M1.1 MECHANICAL GENERAL NOTES & LEGENDS
- M2.1 MECHANICAL SCHEDULES
- M3.1 MECHANICAL DEMOLITION PLANS
- M4.1 CENTRAL PLANT HYDRONIC INSTALLATION PLAN & DETAILS
- M5.1 500-WING HVAC INSTALLATION PLAN
- M7.1 HYDRONIC PLANT PIPING DIAGRAM
- M8.1 BUILDING AUTOMATION SYSTEM SCOPE
- M8.2 BUILDING AUTOMATION SYSTEM SCOPE
- M9.1 MECHANICAL DETAILS
- E1.1 ELECTRICAL GENERAL NOTES & LEGENDS
- E2.1 ELECTRICAL SCHEDULES
- E2.2 ELECTRICAL SCHEDULES
- E2.3 ELECTRICAL SCHEDULES
- E2.4 ELECTRICAL SCHEDULES
- E2.5 ELECTRICAL SCHEDULES
- E2.6 ELECTRICAL SCHEDULES
- E4.0 ELECTRICAL OVERALL POWER PLAN
- E4.1 ELECTRICAL POWER PLAN
- E4.1A ELECTRICAL POWER PLAN PHOTOS
- E4.2 ELECTRICAL POWER PLAN
- E4.3 ELECTRICAL POWER PLAN
- E4.4 ELECTRICAL POWER PLAN
- E4.5 ELECTRICAL POWER PLAN
- E4.6 ELECTRICAL POWER PLAN
- E4.7 ELECTRICAL POWER PLAN
- E4.8 ELECTRICAL POWER PLAN
- E5.1 ELECTRICAL LIGHTING PLAN
- P1.1 PLUMBING GENERAL NOTES, LEGENDS & SCHEDULES
- P1.2 PLUMBING SCHEDULES

- P4.0 PLUMBING OVERALL CAMPUS PLAN
- P4.1 PLUMBING DEMOLITION/INSTALLATION PLAN
- P4.2 PLUMBING RENOVATION PLAN
- P4.3 PLUMBING RENOVATION PLAN
- P8.1 PLUMBING ISOMETRIC DIAGRAM
- P9.1 PLUMBING DETAILS
- R1.0 TYPICAL ROOF DETAILS
- S1.1 STRUCTURAL NOTES AND ABBREVIATIONS
- S1.2 SPECIAL INSPECTIONS
- S2.1 EXISTING FRAMING PLAN 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:

List of Specifications:

DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS

REFER TO DIVISION 00 TABLE OF CONTENTS ON PAGE 1 OF THIS SECTION

DIVISION 01 - GENERAL REQUIREMENTS

- 011000 SUMMARY
- 011020 ALLOWANCES
- 012300 ALTERNATES
- 012513 SUBSTITUTION
- 013113 COORDINATION
- 013119 PROJECT MEETINGS
- 013300 SUBMITTALS
- 013546 INDOOR AIR QUALITY
- 014200 REFERENCES
- 014500 QUALITY CONTROL
- 017329 CUTTING PATCHING
- 017419 CONSTRUCTION WASTE MANAGEMENT
- 017700 CONTRACT CLOSEOUT
- 017836 WARRANTIES
- 018113 SUSTAINABLE CONSTRUCTION REQUIREMENTS
- 018113 APPENDICES A & B
- 019113 GENERAL COMMISSIONING REQUIREMENTS

DIVISION 02 – EXISTING CONDITIONS

028200 ASBESTOS ABATEMENT (by Fercam Group abatement consultants under separate contract to AISD)

DIVISION 03 THROUGH 06 – NOT USED

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

075020 MODIFIED BITUMINOUS MEMBRANE ROOFING

076000 SHEET METAL FLASHING AND TRIM

DIVISION 08 THROUGH 21 – NOT USED

DIVISION 22 – PLUMBING

220000 GENERAL REQUIREMENT FOR PLUMBING

220100 COMMISSIONING OF PLUMBING SYSTEMS

220517 SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

220518 ESCUTCHEONS FOR PLUMBING PIPING

220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING

220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

220719 PLUMBING PIPING INSULATION

221112 WATER DISTRIBUTION PIPING

221119 DOMESTIC WATER PIPING SPECIALTIES

221123 FACILITY NATURAL-GAS PIPING

221316 SANITARY WASTE AND VENT PIPING

DIVISION 23 – MECHANICAL

230000 GENERAL REQUIREMENTS FOR MECHANICAL WORK

230100 COMMISSIONING OF MECHANICAL SYSTEMS

230517 SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

230518 ESCUTCHEONS FOR HVAC PIPING

230519 METERS AND GAGES FOR HVAC PIPING

230523 GENERAL-DUTY VALVES FOR HVAC PIPING

230529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

230548 VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

230593 TESTING, ADJUSTING & BALANCING

230713 DUCT INSULATION

230719 HVAC PIPING INSULATION

230926A DDC CONTROLS FOR LOCAL BUILDING AUTOMATION SYSTEMS TRIDIUM-BACNET
WEB BASED

230926C COMMISSIONING OF BUILDING AUTOMATION SYSTEM (BACNET)

232113 HYDRONIC PIPING

232123 HYDRONIC PUMPS

233113 METAL DUCTS

233300 DUCT ACCESSORIES

235700 HEAT EXCHANGERS FOR HVAC

237100 ROOF-RELATED MECHANICAL PROVISIONS
238146 WATER SOURCE HEAT PUMPS
238460 ENERGY RECOVERY VENTILATORS

DIVISION 24 THROUGH 25 – NOT USED

DIVISION 26 – ELECTRICAL

260000 GENERAL REQUIREMENTS FOR ELECTRICAL WORK
260100 COMMISSIONING OF ELECTRICAL SYSTEMS
260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260523 CONTROL-VOLTAGE ELECTRICAL POWER CABLES
260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
260544 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
260923 LIGHTING CONTROL DEVICES
262413 SWITCHBOARDS
262416 PANELBOARDS
262726 WIRING DEVICES
262813 FUSES
262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
262913 ENCLOSED CONTROLLERS
264313 SURGE PROTECTIVE DEVICES
265600 EXTERIOR LIGHTING
267100 ROOF-RELATED ELECTRICAL PROVISIONS

LIST OF MEMBERS OF BOARD OF TRUSTEES

Austin Independent School District*

Geronimo M. Rodriguez, Jr. , President, District 6

Julie Cowan, Secretary, District 4

Edmund T. Gordon, District 1

Jayme Mathias, District 2

Ann Teich, District 3

Amber Elenz, District 5

Yasmin Wagner, District 7

Cindy Anderson, At-Large Position 8

Paul Cruz, Ph.D., Superintendent

Nicole Conley Johnson, Chief Business Officer

REQUEST FOR 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"):

- 1.1.1. Upgrade of central plant equipment and controls.
- 1.1.2. Upgrade of 500-wing water source heat pumps and controls.
- 1.1.3. Replacement of various electrical distribution equipment.
- 1.1.4. Upgrade of site lighting.
- 1.1.5. Replacement of Kitchen sanitary waste and vent piping plus upgrade of domestic hot water heaters.
- 1.1.6. Replacement of gymnasium shower mixing valves.

To be constructed at the following location ("Project Site"):
O'Henry Middle School, 2610 West 10th Street, Austin, TX 78703

1.2. Estimated Project Budget: \$1.37 Million

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"):

Minimum 5 years of demonstrated experience with projects of similar size and complexity.

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. REQUEST FOR PROPOSALS

2.1. This Request for Proposals ("Request for Proposals") consists of the following documents:

- Advertisement for Request for Proposals;
- Instructions to Offerors;
- Proposal Form;
- Any Contract Documents referenced in this Request for Proposals;
- Any addenda to this Request for Proposals issued by AISD;
- Attached forms; and
- Proposal/Bid Bond Form.

3. DRAWINGS, SPECIFICATIONS, CONTRACT DOCUMENTS AND ADDENDA

- 3.1. The "Contract Documents" for this Request for 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 Proposals as the "Contract."
- 3.2. Copies of Drawings, Specifications, Contract Documents, and Addenda (if any) and other documents related to this Request for 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. The Drawings, Specifications and Addenda (if any) are also available for viewing at various local plan rooms.
- 3.3. 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

4. FORMAT FOR PROPOSALS

- 4.1. Each proposal ("Proposal") submitted by an offeror ("Offeror") must contain the following:
 - The completed Proposal Form (including the Offeror information in Section D thereof);
 - The Proposal Guaranty
 - The completed Felony Conviction Notice;
 - The completed Suspension and Debarment Certification
- 4.2. Additional forms required within 24 hours of Bid Proposal Deadline to proconteam@austinisd.org :
 - The completed HUB documents pertaining to this project:
- 4.3. The Proposal information must be typed on the Proposal Form.
- 4.4. 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.
- 4.5. 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.

5. METHOD OF SELECTING CONTRACTOR

- 5.1. The bidder/proposer MUST submit a completed HUB ATT 1-HUR Form. 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.
- 5.2. 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.
- 5.3. 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.

6. SELECTION CRITERIA

- 6.1. 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>
Construction Cost as Proposed	45%
Relevant Experience and Past Performance	30%
Proposed Personnel/Resources	10%
Financial Condition	8%
Safety Record	7%

7. QUESTIONS REGARDING THIS REQUEST FOR PROPOSALS

- 7.1. 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.

8. PROPOSAL GUARANTY

- 8.1. 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).
- 8.2. The Proposal Guaranty shall be in the form of a Proposal Bond in the form included with this Request for 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.

- 8.3. 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.
- 8.4. 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.

9. SUBSTITUTION OF MATERIALS

- 9.1. 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.

10. BOND AND INSURANCE REQUIREMENTS

- 10.1. 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.
- 10.2. 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.
- 10.3. 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.

11. SAFETY PROGRAM MANUAL AND PROJECT SAFETY PLAN REQUIREMENTS

- 11.1. 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.
- 11.2. 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.

12. PREVAILING WAGE RATES

- 12.1. 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.

13. EXAMINATION OF SITE AND CONTRACT DOCUMENTS

- 13.1. 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.

14. PUBLIC INFORMATION

- 14.1. 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.
- 14.2. 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.

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

- 15.1. 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.
- 15.2. 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.

16. WAIVER OF CLAIMS

- 16.1. **EACH OFFEROR BY SUBMISSION OF A PROPOSAL TO THIS REQUEST FOR 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 PROPOSALS, INCLUDING, THE ADMINISTRATION OF THE REQUEST FOR 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.

17. CONFLICT OF INTEREST QUESTIONNAIRE

17.1. 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>.

18. DISCLOSURE OF INTERESTED PARTIES

18.1 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.

18.2 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) 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. Submission of a response to this Request for Proposals indicates Offeror's acceptance and intended compliance with these requirements.

19. FEEDBACK TO SUBCONTRACTORS/SUPPLIERS

19.1. 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.).

20. SOLICITATION OF "COMPONENT" BIDS AND PROPOSALS FROM SUBCONTRACTORS

20.1. 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 RFP No. 19CSP070

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

Project Number: 19-0040-OHNRV

Project Title: Renovations at O'Henry Middle School

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

1. Upgrade of central plant equipment and controls.
2. Upgrade of 500-wing water source heat pumps and controls.
3. Replacement of various electrical distribution equipment.
4. Upgrade of site lighting.
5. Replacement of Kitchen sanitary waste and vent piping plus upgrade of domestic hot water heaters.
6. Replacement of gymnasium shower mixing valves.

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 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 Proposals.

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

Base Proposal _____

(\$ _____)

Indicate the amount of HAZMAT Abatement included in the Base Proposal. This includes all work defined by drawings and specifications prepared by Fercam Group.

(\$ _____)

Alternate No. 1 (also referred to in the documents as "Price Scope No. 1"): ADD for extending warranty from 5 years to 10 years for select equipment as noted on sheet M2.1

(\$)

A.2 Substantial Completion Date

All of the Work must be substantially completed no later than **August 2, 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: **\$500**.

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 the Proposal Deadline pursuant to Section 4.7 of the Request for Proposals Instructions to Offerors ("Request for Proposals") regarding the Work:

- i. The completed Felony Conviction Notice;
- ii. The completed Suspension and Debarment Certification Form;
- iii. **The following completed HUB documents:**
 - HUBATT 1-HUR
 - HUBATT 1C-HCP
 - Good Faith Effort documentation when required, for Base Bid AND each alternate (if applicable)

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 PROPOSALS, INCLUDING, THE ADMINISTRATION OF THE REQUEST FOR 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 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 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 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 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: \$ _____								

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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: \$ _____											

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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: \$_____											

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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.
15.	16.
17.	18.
19.	20.
21.	22.
23.	24.

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GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION
TABLE OF ARTICLES AND SECTIONS

1. GENERAL PROVISIONS
 - 1.1 Definitions
 - 1.2 Correlation and Intent
 - 1.3 Ownership and Use of Drawings, Specifications and Other Instruments of Service

2. RESPONSIBILITIES OF THE ARCHITECT/ENGINEER
 - 2.1 Owner/Architect/Engineer Relationship
 - 2.2 Contract Administration

3. RESPONSIBILITIES OF THE CONTRACTOR
 - 3.1 Supervision and Duty
 - 3.2 Conditions Affecting the Work
 - 3.3 Differing Site Conditions
 - 3.4 Permits, Fees and Responsibilities
 - 3.5 Patents, Copyrights and Licenses
 - 3.6 Construction Schedule
 - 3.7 Submittals
 - 3.8 Materials and Workmanship
 - 3.9 As-Built Drawings
 - 3.10 Cleanup
 - 3.11 Warranties
 - 3.12 Indemnification
 - 3.13 Repairs for Damaged Property, Improvements and Work
 - 3.14 Substitutions of Materials or Equipment
 - 3.15 Criminal History Record Information Review and Identification Badges for Covered Employees
 - 3.16 Criminal History Record Information Review and Identification Badges for Non-covered Employees

4. SUBCONTRACTORS
 - 4.1 Award of Subcontracts for Portions of the Work
 - 4.2 Subcontractual Relations

- 4.3 Contingent Assignment of Subcontracts
- 5. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
 - 5.1 Owner's Right to Perform Construction and to Award Separate Contracts
 - 5.2 Mutual Responsibility of Contractors
- 6. CHANGES IN THE WORK
 - 6.1 Change Orders
 - 6.2 The Change Order Request Process
 - 6.3 Agreed and Unilateral Change Orders
 - 6.4 Interim Change Authorization
 - 6.5 Change Order Requested by Contractor
 - 6.6 Basis for Compensation for Changes
- 7. TIME DELAY
 - 7.1 Contractor Excused Delays
 - 7.2 Owner Excused Delays
 - 7.3 Contractor Remedies for Delay
 - 7.4 Owner Remedies for Delay
- 8. PAYMENTS AND COMPLETION
 - 8.1 Progress Payments
 - 8.2 Payments Withheld or Nullified
 - 8.3 Substantial Completion
 - 8.4 Final Acceptance and Payment
- 9. PROTECTION OF PERSONS AND PROPERTY
 - 9.1 Safety Precautions and Programs
 - 9.2 Emergency Facilities
 - 9.3 Safety of Persons and Property
 - 9.4 School Safety Requirements
 - 9.5 Location and Protection of Utilities
 - 9.6 Asbestos
 - 9.7 Hazardous Substances
 - 9.8 Contractor's Safety Program Manual
 - 9.9 Contractor's Safety Plan
 - 9.10 Emergencies
 - 9.11 Offsite Work

10. INSURANCE AND BONDS

- 10.1 Required Insurance Coverage
- 10.2 General Requirements
- 10.3 Business Automobile Liability Insurance
- 10.4 Workers Compensation and Employers' Liability Insurance
- 10.5 Commercial General Liability Insurance
- 10.6 Builder's Risk Insurance
- 10.7 Hazardous Materials Insurance
- 10.8 Professional Liability Insurance
- 10.9 Bonds
- 10.10 Additional Bonds Requirements If Contract Amount Is Not Established When Contract Signed
- 10.11 Waiver of Subrogation

11. INSPECTIONS, TESTS AND CORRECTION OF WORK

- 11.1 Times and Places
- 11.2 Continuing Responsibility
- 11.3 Inspections and Testing
- 11.4 Rejected Material or Work
- 11.5 Cooperation
- 11.6 Covered Work

12. MISCELLANEOUS PROVISIONS

- 12.1 Third Parties
- 12.2 Bankruptcy
- 12.3 No waiver of Default
- 12.4 Severability
- 12.5 Construction

13. TERMINATION OR SUSPENSION OF THE CONTRACT

- 13.1 Suspensions of the Work for Owner's Convenience
- 13.2 Responsibility for Completion
- 13.3 Events of Default
- 13.4 Termination for Convenience of Owner
- 13.5 Termination for Contractor's Default

14. ADMINISTRATIVE PROCEDURE FOR CONTRACTOR CLAIMS

- 14.1 Administrative Procedure for Resolution of Claims

15. PARTIAL USE OR OCCUPANCY

16. TAXES

17. NOTICE TO PARTIES
18. NOTICES REQUIRED TO BE POSTED
 - 18.01 Job Site Postings
19. PREVAILING WAGE RATES

**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 and final 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 to determine the date or dates of Substantial Completion and the date of Final Completion. 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 repairs 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 form Disclosure Statement/HUB* Utilization Report supplied by Owner or such other form required

by Owner (“Disclosure 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 Disclosure 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 Disclosure Statement, Owner and the Architect/Engineer shall be deemed to have approved each subcontractor and supplier on the Disclosure 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 Disclosure Statement reflecting the proposed replacement. Contractor shall submit an amended Disclosure 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 Disclosure 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, including Substantial Completion Date and Final Completion Date, are 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 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 Disclosure 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 Disclosure Statement 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 10th 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 10th 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 Disclosure Statement 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 31st 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 46th 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 10th 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 (6th) 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
 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. 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 disclosure, 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 disclosure 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.

9.8 CONTRACTOR'S SAFETY PROGRAM MANUAL

- 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 5th 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

Contractor must post at Project site. This notice must be printed with a title in at least 30 point bold type and text in at least 19 point normal type, and shall be in both English and Spanish and any other language common to Contractor's employee population.

NOTICE OF REQUIRED WORKERS' COMPENSATION COVERAGE

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.

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 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: _____

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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: _____

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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:

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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:

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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 6th 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:

W I T N E S S E T H:

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 6th Street
Ste. A-330
Austin, Texas 78703
Attn: Executive Director, Contract & Procurement Services
Telephone: (512) 414-2161

With copy to Architect/Engineer:

Telephone: _____
Email: _____

If to Contractor:

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: _____

Date: _____

CONTRACTOR:

By: _____

Name: _____

Title: _____

Date: _____

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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 prevaletientes 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 prevaletientes aplicables.
- Los ayudantes no se clasifican por separado en las tarifas salariales prevaletientes 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.

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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@fcbackground.com | (832) 277-0719

FC Background, Customer Support | customer.support@fcbackground.com | (800) 388-8827

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Austin Independent School District

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

CERTIFICATE OF INSURANCE

This Certificate shall be completed by a licensed insurance agent:

Name and Address of Agency: _____ AISD Reference: _____
 _____ Project Name: _____
 _____ Project Mgr.: _____
 _____ Project No.: _____
 Phone: _____ / Fax: _____

Name and Address of Insured: _____ **Insurers Affording Coverages:**
 _____ Insurer A: _____
 _____ Insurer B: _____
 Vendor/Sole Proprietor: _____ Insurer C: _____
 _____ 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	
	Commercial General Liability Policy 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					\$
					Occurrence	\$

Pollution/ Environmental Impairment Policy					Aggregate	\$
INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YYYY)	POLICY EXPIRATION DATE (MM/DD/YYYY)	LIMITS OF LIABILITY	
	Auto Liability Policy Which of the following are provided coverage: <input type="checkbox"/> Yes <input type="checkbox"/> No -- Any Auto <input type="checkbox"/> Yes <input type="checkbox"/> No -- All Owned Autos <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				CSL	\$
					Bodily Injury (Per Accident)	\$
					Bodily Injury (Per Person)	\$
					Property Damage (Per Accident)	\$
	Excess Liability <input type="checkbox"/> Umbrella Form <input type="checkbox"/> Excess Liability Follow Form				Occurrence	\$
					Aggregate	\$
	Workers' Compensation and Employers' Liability Does the policy include the following endorsements: <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"/> Statutory	
					Each Accident	\$
					Disease – Policy Limit	\$
					Disease – Each Employee	\$
	Is a Builder Risk/Property/IM/ Installation Insurance policy provided? <input type="checkbox"/> Yes <input type="checkbox"/> No				\$	\$
	<input type="checkbox"/> Yes <input type="checkbox"/> No -- Is AISD shown as loss payee/mortgagee?					
	Professional Liability <input type="checkbox"/> 30 Day Notice of Cancellation Retroactive Date: _____				Each Claim	\$
					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 6th Street

 AUTHORIZED REPRESENTATIVE SIGNATURE
 Licensed Insurance Agent

Austin, Texas 78703

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
By: _____
Title: _____
Address: _____

Surety
By: _____
Title: _____
Address: _____

Telephone: _____ Fax: _____
E-Mail 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.

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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
By: _____
Title: _____
Address: _____

Surety
By: _____
Title: _____
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.

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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)

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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 51st 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.

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IMPORTANT INFORMATION



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."

INFORMACION IMPORTANTE



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".

AUSTIN INDEPENDENT SCHOOL DISTRICT

ESTIMATE FOR PARTIAL PAYMENT

(PROVIDE 2 COPIES OF ESTIMATE TO AISD)

PROJECT TITLE _____ PROJECT NO. _____
 CONTRACTOR _____ (Firm Name) _____ (Mailing Address)
 Original Contract Price \$ _____ Date _____
 Change Order Add. Costs \$ _____ P.O. No. _____ Est. No. _____
 Total \$ _____
 Change Order Credits \$ _____
 Total Contract to Date \$ _____ Contract No. _____
 Estimate Period _____ to _____ Account Code _____

SCHEDULE OF VALUES

A ITEM NO.	B ITEM DESCRIPTION	C SCHEDULED VALUE	D PERCENT		F AMOUNT PREVIOUS ESTIMATE	G AMOUNT THIS ESTIMATE	H MAT'L'S. PRESENTLY STORED (NOT IN F OR G)	I TOTAL COMPLETED AND STORED TO DATE (F+G+H)	J BALANCE TO FINISH (C-I)
			THIS EST	TO DATE					

Prepared by: _____
 CONTRACTOR'S REPRESENTATIVE / TITLE

Total amount of contract performed to date..... \$ _____

The undersigned Contractor certifies to the best of its knowledge, the work covered by this Estimate for Partial Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

Less Retainage..... \$ _____

Signature _____ DATE

Amount due to date..... \$ _____

Approved: _____
 CONSULTING FIRM

Amount paid on previous estimates..... \$ _____

By: _____

Amount due on this estimate..... \$ _____

Approved: _____
 AISD PROJECT MANAGER DATE

Approved: _____
 AISD ASSISTANT DIRECTOR, DATE
 CONSTR. MGMT/CAMPUS SUPPORT.
 SUPERVISOR

Approved: _____
 AISD DIRECTOR, CONSTR. MGMT. DATE

AUSTIN INDEPENDENT SCHOOL DISTRICT
ESTIMATE FOR PARTIAL PAYMENT
CONTINUATION SHEET
 (PROVIDE 2 COPIES OF ESTIMATE TO AISD)

PROJECT _____

PROJECT NO. _____

SCHEDULE OF VALUES

A ITEM NO.	B ITEM DESCRIPTION	C SCHEDULED VALUE	D PERCENT		F AMOUNT PREVIOUS ESTIMATE	G AMOUNT THIS ESTIMATE	H MAT'LS. PRESENTLY STORED (NOT IN F OR G)	I TOTAL COMPLETED AND STORED TO DATE (F+G+H)	J BALANCE TO FINISH (C-I)
			THIS EST	TO DATE					

INTERIM CHANGE AUTHORIZATION NO.



_____ Date: _____
Project Title

_____ Project Architect/Engineer (A/E) _____ Project No.

To Contractor:

You are hereby directed to promptly execute this Interim Change Authorization which changes the Work, Contract Amount, and if required, Contract Time.

This Work shall be included in and become a part of a Change Order for this contract. Billings may be made for this work in an amount not to exceed 50% of the "Additional cost not to exceed" amount stated below. Billings shall not be made for the balance of the cost of this work until the related Change Order is processed and approved by all parties.

By copy of this Interim Change Authorization, the A/E named above is directed to immediately issue a Change Order Request on the appropriate form.

Additional cost not to exceed: _____

Additional days not to exceed: _____

Description of work:

Recommended: _____
AISD Project Manager Date

Recommended: _____
AISD Assistant Director, Constr.
Mgmt/Campus Support Supervisor Date

Approved: _____
AISD Director, Construction Management Date

XC:

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AUSTIN INDEPENDENT SCHOOL DISTRICT
CHANGE ORDER NO. _____
 (Submit 1 original)

Project Title _____

Project No. _____

<u>CONTRACT AMOUNT</u>	
ORIGINAL CONTRACT	_____
TOTAL PREVIOUS CHANGES	_____
TOTAL THIS CHANGE	\$ _____ -
TOTAL CONTRACT	\$ _____ -

<u>CONTRACT TIME (Calendar Days)</u>	
Original Contract Time	_____ 100
TOTAL PREVIOUS CHANGE	_____ 15
TOTAL THIS CHANGE	_____ 15
TOTAL CONTRACT	_____ 130

<u>PERCENT OF ORIGINAL CONTRACT PRICE</u>	
Previous Change Orders	0.0%
This Change Order	0.0%
Total % Change	0.0%

NTP Date: _____ 01/01/00
 Original Completion Date: _____ 04/10/00
 Existing Completion Date: _____ 04/25/00
 Amended Completion Date: _____ 05/10/00
 Orig. Contract Time is hereby extended 30 calendar days.

P.O. #: _____ PM Initial

*Hazmat issues were considered during the development of this change order				
Item No.	Change Order Request	Item Title	Calendar Days	Total Amount of Item
1				
Item Description (including author and reason)		Reason Code:		
2				
Item Description (including author and reason)		Reason Code:		
3				
Item Description (including author and reason)		Reason Code:		
Page One Subtotal			0	\$ -
Page Two Sub-Total			0	\$ -
Change Order Total			0	\$ -

 Contractor or Construction Management Company

By: _____
 Signature Date

Recommended:

 AISD Project Manager, Construction Management
 Date

 AISD Assistant Director, Construction
 Management Date

Recommended by A/E:

 Architect/Engineering Firm

By: _____
 Signature Date

Approved:

 AISD Director, Construction Management Date

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AUSTIN INDEPENDENT SCHOOL DISTRICT
CHANGE ORDER NO. _____
 (Submit 1 original)

Project Title			Project No.	
Item No.	Change Order Request	Item Title	Calendar Days	Total Amount of Item
4				
Item Description (including author and reason)		Reason Code:		
5				
Item Description (including author and reason)		Reason Code:		
6				
Item Description (including author and reason)		Reason Code:		
7				
Item Description (including author and reason)		Reason Code:		
8				
Item Description (including author and reason)		Reason Code:		
9				
Item Description (including author and reason)		Reason Code:		
10				
Item Description (including author and reason)		Reason Code:		
11				
Item Description (including author and reason)		Reason Code:		
Page Two Subtotal				\$ -

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AUSTIN INDEPENDENT SCHOOL DISTRICT
TIME EXTENSION REQUEST NO. _____ CHANGE ORDER NO. _____
 (Submit 1 original) (If approved by AISD)

Project Title _____	Project Number _____
NOTES TO CONTRACTOR:	
1. Below, list each day for which a time extension is requested in conformance with the Contract Documents. Also provide for each day requested the month, year, and justification including the cause(s) and related documentation.	
2. A Time Extension Request must be submitted with each progress payment submission. In the event no time extension is requested, submit the form and enter a statement in the Justification area below indicating no extension is requested.	
3. If more space is needed below to indicate all of the days, add extra pages as necessary.	

Month	Work Day	Year	Justification	A/E No. Days (By A/E)	Days Apprvd. (By AISD)
Totals					

	(This area to be filled in by A/E)
Contractor or Construction Manager Company	Recommended: _____ Architecture/Engineering Firm
By: _____	By: _____
Signature _____ Date _____	Signature _____ Date _____

(This area to be filled in by AISD)	
Total No. Days Approved by AISD: 	
<u>Calendar Days</u>	
Original Contract Period _____	Recommended:
Previous Additions _____	
Previous Deductions _____	
TOTAL PREVIOUS CHANGE _____	
This TER Add _____	Recommended:
This TER Deduct _____	
TOTAL THIS CHANGE _____	
TOTAL CONTRACT _____	
<u>Dates</u>	
Work Start Date _____	AISD Project Manager _____ Date _____
Orig. Substantial Completion _____	AISD Asst. Dir. Const. Mgt. or Campus Support Super. _____ Date _____
Current Substantial Completion _____	Approved:
Amended Substantial Completion _____	
AISD Director of Construction Management _____ Date _____	



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**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.

1. PROJECT INFORMATION

Facility:

DISTRICT:

Address:

ARCHITECT/ENGINEER:

City:

CONTRACTOR / CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

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

3. The District certifies that the 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:

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:

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:

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

DISTRICT:

BY:

DATE:

INSTRUCTIONS FOR COMPLETION OF CERTIFICATION OF PROJECT COMPLIANCE” FORM

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.

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

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.

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.

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.

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

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 δ
 δ
COUNTY OF TRAVISδ

The undersigned executive officer, general partner or proprietor of:

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.

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

_____ day of _____, 20 ____.

Notary Public State of Texas

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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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DIVISION 01

GENERAL REQUIREMENTS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Project information.
 2. Work covered by Contract Documents.
 3. Phased construction.
 4. Work by Owner.
 5. Work under separate contracts.
 6. Future work.
 7. Purchase contracts.
 8. Owner-furnished products.
 9. Contractor-furnished, Owner-installed products.
 10. Access to site.
 11. Coordination with occupants.
 12. Work restrictions.
 13. Specification and drawing conventions.
 14. Miscellaneous provisions.

1.3 PROJECT INFORMATION

- A. Project Identification:

AUSTIN INDEPENDENT SCHOOL DISTRICT
Project No.: 19-0040-OHNRV
Renovations at O'Henry Middle School

1. Project Location:

O'Henry Middle School, 2610 West 10th Street, Austin, TX 78703

- B. Owner: Austin ISD, 812 San Antonio, Suite 200, Austin, TX 78701

1. Owner's Representative:

Rick Kaven, P.E., Project Manager
Phone: (512) 414-8947

Engineer:

Saleem, Khan, P.E., CxA

Mitch Bible, P.E.

Texas Energy Engineering Services Inc. (d/b/a TEESI Engineering)

1301 S. Capital of TX HWY, B-325

Austin, Texas, 78746

Phone: (512) 328-2533

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Upgrade of central plant equipment and controls.
2. Upgrade of 500-wing water source heat pumps and controls.
3. Replacement of various electrical distribution equipment.
4. Upgrade of site lighting.
5. Replacement of Kitchen sanitary waste and vent piping plus upgrade of domestic hot water heaters.
6. Replacement of gymnasium shower mixing valves.

1.5 PHASED CONSTRUCTION – N/A

1.6 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.7 WORK UNDER SEPARATE CONTRACTS – N/A

1.8 FUTURE WORK – N/A

1.9 PURCHASE CONTRACTS - N/A

1.10 OWNER-FURNISHED PRODUCTS – N/A

1.11 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS – N/A

1.12 ACCESS TO SITE

- A. General: Contractor shall coordinate with owner shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
 - 1. Driveways, Walkways and Entrances: Keep driveways, loading areas and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather tight condition throughout construction period. Repair damage caused by construction operations.

1.13 COORDINATION WITH OCCUPANTS

- A. Contractor is anticipated to have full access to the site 24/7 from June 2, 2019 till substantial completion date of August 3, 2019. Owner will occupy parts of the building (not included in major scope of work) building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than **72** hours in advance of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. AISD to provide a Certificate of Substantial Completion for the work prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 - 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.14 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours:

1. Contractor operations shall not disrupt the District's regular operations or classroom activities in any way. Any work affecting regular operations or classroom activities shall be scheduled in advance with the District, and performed after hours, reference Work Plan requirements in specification.
2. Within reasonable limits and actual operating restraints the District will attempt to maximize the Contractor's scheduled access to buildings. Conversely, Contractor shall maximize his/her installation efforts during any and all of District's scheduled holiday and downtime periods. Other such periods will be identified at the pre-construction meeting and the project meetings as the work progresses.
3. Safety: The Contractor shall maintain the workplace in a safe condition at all times. All openings shall be substantially barricaded (tape not acceptable).

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify **Engineer, Construction Manager and Owner** not less than **two** days in advance of proposed utility interruptions.
2. Obtain **Engineer, Construction Manager's** and **Owner's** written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify **Engineer, Construction Manager, and Owner** not less than **two** days in advance of proposed disruptive operations.
2. Obtain **Engineer, Construction Manager's** and **Owner's** written permission before proceeding with disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

F. Controlled Substances: Use of tobacco products and other controlled substances within the existing building on Project site is not permitted.

G. Employee Identification: Require contractor personnel to use identification tags at all times at the work site.

H. Employee Screening: Comply with Owner's requirements for background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.15 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.16 MISCELLANEOUS PROVISIONS – N/A

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 011020 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Related Work of Other Sections:

1. Owner-Contractor Agreement: Contract price including allowances by Contractor.

B. Include in the Base Amount Scope of Work Proposal Amount and in the Construction Contract, a Contingency Allowance, for use upon Owner's instructions, with a stipulated price amount as indicated below:

1. **Ten thousand (\$10,000.00) for plumbing.**
2. **Fifteen thousand (\$15,000.00) for electrical.**
3. **Ten thousand (\$10,000.00) for structural and roofing.**
4. **Five thousand (\$5,000.00) for wire management.**

C. Contractor's costs for products, delivery, installation, labor, insurance, payroll taxes, bonding, equipment rental, overhead and profit will be included in Field Change Orders authorizing expenditure of funds from this Contingency Allowance.

D. Funds will be withdrawn from Allowance by Contingency Allowance Change Order. **The Contractor is not authorized to commit or spend monies from allowance(s) without advance approval from the Owner, via the Contingency Allowance Field Change Order.**

E. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Field Change Order.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 011020

SECTION 012300 - ALTERNATES

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 administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
- B. Alternates may be identified on the drawings as "Price Scope #" where # is the alternate number designation. Refer to descriptions on the bid form.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Price Scope No. 1

1. Additional cost for extending labor and material warranty from 5 years to 10 years for water source heat pumps, heat recovery units, plate-and-frame heat exchangers, and variable frequency drives provided under the base scope.

END OF SECTION 012300

SECTION 012513 – SUBSTITUTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.
 - 1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
 - 2. Division 1 Section "Submittals" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.

1.3 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
 - 1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
 - 2. Revisions to the Contract Documents requested by the Owner or Engineer.
 - 3. Specified options of products and construction methods included in the Contract Documents.
 - 4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

- A. Substitution Request Submittal: The Engineer will consider requests for substitution if received within 60 days after commencement of the Work. Requests received more than 60 days after commencement of the Work may be considered or rejected at the discretion of the Engineer.
 - 1. Submit electronic copy of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.

2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed substitution.
 - b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
 - c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - g. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
4. Engineer's Action: If necessary, the Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Engineer will notify the Contractor of acceptance or rejection of the substitution within 2 weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a change order.
 - a. Use the product specified if the Engineer cannot make a decision on the use of a proposed substitute within the time allocated.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Conditions: The Engineer will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by the Engineer. If the following conditions are not satisfied, the Engineer will return the requests without action except to record noncompliance with these requirements.
 1. Extensive revisions to the Contract Documents are not required.
 2. Proposed changes are in keeping with the general intent of the Contract Documents.
 3. The request is timely, fully documented, and properly submitted.
 4. The specified product or method of construction cannot be provided within the Contract Time. The Engineer will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
 5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.
 6. The requested substitution offers the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to the Architect for redesign

RENOVATIONS AT O'HENRY MIDDLE SCHOOL (TEESI Project #T1814)
AISD PROJECT # 19-0040-OHNRV

- and evaluation services, increased cost of other construction by the Owner, and similar considerations.
7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.
 9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.
 10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
 11. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.
- B. The Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 012513

SECTION 013113 – COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
 - 1. General project coordination procedures.
 - 2. Conservation.
 - 3. Coordination Drawings.
 - 4. Administrative and supervisory personnel.
 - 5. Cleaning and protection.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Project Meetings" for progress meetings, coordination meetings, and pre-installation conferences.
 - 2. Division 1 Section "Submittals" for preparing and submitting the Contractor's Construction Schedule.
 - 3. Division 1 Section "Contract Closeout" for coordinating contract closeout.

1.3 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - 3. Make provisions to accommodate items scheduled for later installation.
- B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the Owner and separate contractors where coordination of their work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project closeout activities.

D. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Comply with requirements contained in Section "Submittals."

B. Staff Names: Within 15 days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.

1. Post copies of the list in the Project meeting room, the temporary field office, and each temporary telephone.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.2 CLEANING AND PROTECTION

- A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

- B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

- C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 - 1. Excessive static or dynamic loading.
 - 2. Excessive internal or external pressures.
 - 3. Excessively high or low temperatures.
 - 4. Thermal shock.
 - 5. Excessively high or low humidity.
 - 6. Air contamination or pollution.
 - 7. Water or ice.
 - 8. Solvents.
 - 9. Chemicals.
 - 10. Light.
 - 11. Radiation.
 - 12. Puncture.
 - 13. Abrasion.
 - 14. Heavy traffic.
 - 15. Soiling, staining, and corrosion.
 - 16. Bacteria.
 - 17. Rodent and insect infestation.
 - 18. Combustion.
 - 19. Electrical current.
 - 20. High-speed operation.
 - 21. Improper lubrication.
 - 22. Unusual wear or other misuse.
 - 23. Contact between incompatible materials.
 - 24. Destructive testing.
 - 25. Misalignment.
 - 26. Excessive weathering.
 - 27. Unprotected storage.
 - 28. Improper shipping or handling.
 - 29. Theft.
 - 30. Vandalism.

END OF SECTION 013113

SECTION 013119 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
 - 1. Preconstruction conferences.
 - 2. Preinstallation conferences.
 - 3. Progress meetings.
 - 4. Coordination meetings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Coordination" for procedures for coordinating project meetings with other construction activities.
 - 2. Division 1 Section "Submittals" for submitting the Contractor's Construction Schedule.
 - 3. Division 26 and related sections for preinstallation conferences.

1.3 PRECONSTRUCTION CONFERENCE

- A. Schedule a preconstruction conference before starting construction, at a time convenient to the Owner and the Engineer, but no later than 15 days after execution of the Agreement. Hold the conference at the Project Site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attendees: Authorized representatives of the Owner, Engineer, and their consultants; the Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
- C. Agenda: Discuss items of significance that could affect progress, including the following:
 - 1. Tentative construction schedule.
 - 2. Critical work sequencing.
 - 3. Designation of responsible personnel.
 - 4. Procedures for processing field decisions and Change Orders.
 - 5. Procedures for processing Applications for Payment.
 - 6. Distribution of Contract Documents.
 - 7. Submittal of Shop Drawings, Product Data, and Samples.
 - 8. Preparation of record documents.
 - 9. Use of the premises.
 - 10. Parking availability.

11. Office, work, and storage areas.
12. Equipment deliveries and priorities.
13. Safety procedures.
14. First aid.
15. Security.
16. Housekeeping.
17. Working hours.

1.4 PREINSTALLATION CONFERENCES

- A. Conduct a preinstallation conference at the Project Site before each construction activity that requires coordination with other construction.
- B. Attendees: The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Engineer of scheduled meeting dates.
 1. Review the progress of other construction activities and preparations for the particular activity under consideration at each preinstallation conference, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related Change Orders.
 - d. Purchases.
 - e. Deliveries.
 - f. Shop Drawings, Product Data, and quality-control samples.
 - g. Review of mockups.
 - h. Possible conflicts.
 - i. Compatibility problems.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's recommendations.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.
 - p. Temporary facilities.
 - q. Space and access limitations.
 - r. Governing regulations.
 - s. Safety.
 - t. Inspecting and testing requirements.
 - u. Required performance results.
 - v. Recording requirements.
 - w. Protection.
 2. Record significant discussions and agreements and disagreements of each conference, and the approved schedule. Promptly distribute the record of the meeting to everyone concerned, including the Owner and the Engineer.
 3. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.5 PROGRESS MEETINGS

- A. Conduct progress meetings at the Project Site at regular intervals. Notify the Owner and the Engineer of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.
- B. Attendees: In addition to representatives of the Owner and the Engineer, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
 - 1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.
 - 2. Review the present and future needs of each entity present, including the following:
 - a. Interface requirements.
 - b. Time.
 - c. Sequences.
 - d. Status of submittals.
 - e. Deliveries.
 - f. Off-site fabrication problems.
 - g. Access.
 - h. Site utilization.
 - i. Temporary facilities and services.
 - j. Hours of work.
 - k. Hazards and risks.
 - l. Housekeeping.
 - m. Quality and work standards.
 - n. Change Orders.
 - o. Documentation of information for payment requests.
 - p. Tracking of Owner's sustainability scorecard strategies as relevant to the project.
- D. Reporting: No later than 3 days after each meeting, distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - 1. Schedule Updating: Revise the Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

1.6 COORDINATION MEETINGS

- A. Conduct project coordination meetings at regular intervals convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special preinstallation meetings.
- B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

- C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 013119

SECTION 013300 – SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following:
 - 1. Contractor's construction schedule.
 - 2. Work Progress Schedule
 - 3. Schedule of Values
 - 4. Submittal schedule.
 - 5. Daily construction reports.
 - 6. Shop Drawings.
 - 7. Product Data.
 - 8. Samples.
 - 9. Quality assurance submittals.
- B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
 - 1. Permits.
 - 2. Applications for Payment.
 - 3. Performance and payment bonds.
 - 4. Insurance certificates.
 - 5. List of subcontractors.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Coordination" specifies requirements governing preparation and submittal of required Coordination Drawings.
 - 2. Division 1 Section "Project Meetings" specifies requirements for submittal and distribution of meeting and conference minutes.
 - 3. Division 1 Section "Quality Control" specifies requirements for submittal of inspection and test reports.
 - 4. Division 1 Section "Contract Closeout" specifies requirements for submittal of Project Record Documents and warranties at project closeout.

1.3 DEFINITIONS

- A. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended.

1. Preparation of Coordination Drawings is specified in Division 1 Section "Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
- B. Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.

1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
 3. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals.
 - a. Allow 2 weeks for initial review. Allow additional time if the Engineer must delay processing to permit coordination with subsequent submittals.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. Allow 2 weeks for reprocessing each submittal.
 - d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.
- B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
 1. Provide a space approximately 4 by 5 inches on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
 2. Include the following information on the label for processing and recording action taken.
 - a. Project name.
 - b. Date.
 - c. Name and address of the Engineer.
 - d. Name and address of the Contractor.
 - e. Name and address of the subcontractor.
 - f. Name and address of the supplier.
 - g. Name of the manufacturer.
 - h. Number and title of appropriate Specification Section.
 - i. Drawing number and detail references, as appropriate.
- C. Submittal Transmittal: Transmit each submittal electronically to the Owner and Engineer. Copy any parties or subconsultants designated by the Owner or Engineer in the Preconstruction meeting. Include the following information in the electronic file name:
 1. Project ID as requested by the Owner and/or A/E
 2. Relevant specifications section for the submitted item

3. Sequential identifier differentiating multiple submittals from the same section, beginning with 0.
4. Sequential identifier noting the revision iteration of the current submittal, beginning with 0 for the initial submission.
5. Brief description of the submitted item.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart-type, contractor's construction schedule. Submit within 30 days after the date established for "Commencement of the Work."
 1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values."
 2. Within each time bar, indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
 3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
 5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other schedules.
 6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Engineer's procedures necessary for certification of Substantial Completion.
- B. Phasing: On the schedule, show how requirements for phased completion to permit Work by separate Contractors and partial occupancy by the Owner affect the sequence of Work.
- C. Work Stages: Indicate important stages of construction for each major portion of the Work, including submittal review, testing, and installation.
- D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.
- E. Cost Correlation: At the head of the schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of Work performed as of the dates used for preparation of payment requests.
- F. Distribution: Following response to the initial submittal, print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- G. Schedule Updating: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.6 SUBMITTAL SCHEDULE

- A. After development and acceptance of the Contractor's Construction Schedule, prepare a complete schedule of submittals. Submit the schedule within 10 days of the date required for submittal of the Contractor's Construction Schedule.
1. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values, and the list of products as well as the Contractor's Construction Schedule.
 2. Prepare the schedule in chronological order. Provide the following information:
 - a. Scheduled date for the first submittal.
 - b. Related Section number.
 - c. Submittal category (Shop Drawings, Product Data, or Samples).
 - d. Name of the subcontractor.
 - e. Description of the part of the Work covered.
 - f. Scheduled date for resubmittal.
 - g. Scheduled date for the Engineer's final release or approval.
- B. List of Submittals shall comply submittal requirements in respective Specifications Sections:
- C. Distribution: Following response to the initial submittal, print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.
1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- D. Schedule Updating: Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.7 SHOP DRAWINGS

- A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
- B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:
1. Dimensions.
 2. Identification of products and materials included by sheet and detail number.
 3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
 6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
 7. Submittal: Submit electronic copies of shop drawings.
 - a. Shop drawings returned shall be marked up and maintained as a "Record Document."
 8. Do not use Shop Drawings without an appropriate final stamp indicating action taken.

1.8 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves. **Include product data specific to criteria associated with all applicable required AISD sustainability score-card measures and identified voluntary measures.**
1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations for delivery, storage, assembly, installation, start-up, adjusting and finishing in quantities specified for Product data. Identify any conflicts between manufacturers' instructions and Contract Documents
 - b. Compliance with trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
 3. Submittals: Submit electronic copy of each required submittal; submit 4 copies where required for maintenance manuals. The Engineer will retain one and will return the other marked with action taken and corrections or modifications required.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 4. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
 - b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.9 SAMPLES

- A. A/E reserves the right to request physical samples of items in the project as needed to select colors, finishes, etc.
- B. Where required, submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1.10 QUALITY ASSURANCE SUBMITTALS

- A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
 - 1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
- C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."

1.11 ARCHITECT'S/ENGINEER'S ACTION

- A. Except for submittals for the record or information, where action and return is required, the Architect/Engineer will review each submittal, mark to indicate action taken, and return promptly.
 - 1. Compliance with specified characteristics is the Contractor's responsibility.
- B. Submittal Letter: The Engineer will provide a submittal letter in response to equipment this is submitted. The Engineer will indicated the action taken, as follows:
 - 1. Final Unrestricted Release: When the Engineer responds to a submittal "No Exception Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 - 2. Final-But-Restricted Release: When the Engineer responds to a submittal as "Approved as Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
 - 3. Returned for Resubmittal: When the Engineer responds to a submittal as "Not Approved, Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - a. Do not use, or allow others to use, submittals marked "Not Approved, Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.
 - 4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Engineer will return the submittal letter indicating "Action Not Required."
- C. Unsolicited Submittals: The Engineer will return unsolicited submittals to the sender without action.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 013300

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.

END OF SECTION 013546

SECTION 014200 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Engineer, requested by the Engineer, and similar phrases.
- D. "Approved": The term "approved," when used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 - 2. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

- a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.

J. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Format: These Specifications are organized into Divisions and Sections based on the 16-division format and CSI/CSC's "MasterFormat" numbering system.

B. Specification Content: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Section Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Engineer for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.
- F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The following abbreviations and acronyms, as referenced in the Contract Documents, mean the associated names. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

AABC	Associated Air Balance Council 1518 K St., NW, Suite 503 Washington, DC 20005 www.aabchq.com	(202) 737-0202
ABMA	American Bearing Manufacturers Association (Formerly: Anti-Friction Bearing Manufacturers Association) 1200 19th St., NW, Suite 300 Washington, DC 20036-2401 www.abma-dc.org	(202) 429-5155
ABMA	American Boiler Manufacturers Association 950 North Glebe Rd., Suite 160 Arlington, VA 22203-1824 www.abma.com	(703) 522-7350
ACIL	ACIL: The Association of Independent Scientific, Engineering, and Testing Firms 1629 K St., NW, Suite 400 Washington, DC 20006 www.acil.org	(202) 887-5872
ADC	Air Diffusion Council 11 South LaSalle St., Suite 1400 Chicago, IL 60603	(312) 201-0101

AEIC	Association of Edison Illuminating Companies 600 N. 18th St. P.O. Box 2641 Birmingham, AL 35291-0992	(205) 250-2530
AGA	American Gas Association 1515 Wilson Blvd. Arlington, VA 22209 www.aga.com	(703) 841-8400
AIHA	American Industrial Hygiene Association 2700 Prosperity Ave., Suite 250 Fairfax, VA 22031	(703) 849-888
AMCA	Air Movement and Control Association International, Inc. 30 W. University Dr. Arlington Heights, IL 60004-1893 www.amca.org	(847) 394-0150
ANSI	American National Standards Institute 11 West 42nd St., 13th Floor New York, NY 10036-8002 www.ansi.org	(212) 642-4900
AOAC	AOAC International 481 N. Frederick Ave., Suite 500 Gaithersburg, MD 20877	(301) 924-7077
ARI	Air-Conditioning and Refrigeration Institute 4301 Fairfax Dr., Suite 425 Arlington, VA 22203 www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association Center Park 4041 Powder Mill Rd., Suite 404 Calverton, MD 20705	(301) 231-9050
ASA	Acoustical Society of America 500 Sunnyside Blvd. Woodbury, NY 11797	(516) 576-2360
ASC	Adhesive and Sealant Council 1627 K St., NW, Suite 1000 Washington, DC 20006-1707	(202) 452-1500
ASHRAE	American Society of Heating, Refrigerating and Air- Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329-2305 www.ashrae.org	(800) 527-4723 (404) 636-8400

ASME	American Society of Mechanical Engineers 345 East 47th St. New York, NY 10017-2392 www.asme.org	(800) 434-2763 (212) 705-7722
ASPE	American Society of Plumbing Engineers 3617 Thousand Oaks Blvd., Suite 210 Westlake Village, CA 91362-3649	(805) 495-7120
ASSE	American Society of Sanitary Engineering 28901 Clemens Rd. Westlake, OH 44145 www.asse-plumbing.org	(216) 835-3040
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, CO 80235 www.awwa.org	(800) 926-7337 (303) 794-7711
CAGI	Compressed Air and Gas Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/cagi	(216) 241-7333
CBM	Certified Ballast Manufacturers Association 1422 Euclid Ave., Suite 402 Cleveland, OH 44115-2094	(216) 241-0711
CGSB	Canadian General Standards Board Place du Portage Phase III, 6B1 11 Laurier St. Hull, Quebec K1A 1G6 CANADA www.pwgsc.gc.ca/cgsb Mailing Address: Canadian General Standards Board Sales Centre Ottawa K1A 1G5 CANADA	(819) 956-3500 (800) 665-2472 (819) 956-0425
CTI	Cooling Tower Institute P.O. Box 73383 Houston, TX 77273 www.dhi.org	(281) 583-4087
DIPRA	Ductile Iron Pipe Research Association 245 Riverchase Pkwy East, Suite O Birmingham, AL 35244	(205) 988-9870

FM	Factory Mutual System 1151 Boston-Providence Tnpk. P.O. Box 9102 Norwood, MA 02062-9102 www.factorymutual.com	(781) 762-4300
HEI	Heat Exchange Institute c/o Thomas Associates, Inc. 1300 Sumner Ave. Cleveland, OH 44115-2851 www.taol.com/hei	(216) 241-7333
HI	Hydraulic Institute 9 Sylvan Way Parsippany, NJ 07054-3802	(201) 267-9700
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association P.O. Box 218 35 Russo Pl. Berkeley Heights, NJ 07922 www.gamanet.org	(908) 464-8200
IEEE	Institute of Electrical and Electronics Engineers 345 E. 47th St. New York, NY 10017-2394 www.ieee.org	(800) 678-4333 (212) 705-7900
IESNA	Illuminating Engineering Society of North America 120 Wall St., 17th Floor New York, NY 10005-4001 www.iesna.org	(212) 248-5000
INCE	Institute of Noise Control Engineering P.O. Box 3206, Arlington Branch Poughkeepsie, NY 12603	(914) 462-4006
ISA	ISA - International Society for Measurement and Control P.O. Box 12277 67 Alexander Dr. Research Triangle Park, NC 27709 www.isa.org	(919) 549-8411
ISS	Iron and Steel Society 410 Commonwealth Dr. Warrendale, PA 15086-7512 www.issource.org	(412) 776-1535
MCAA	Mechanical Contractors Association of America 1385 Piccard Dr. Rockville, MD 20850-4329 P.O. Box 87A Cumberland Center, ME 04021	(301) 869-5800

NEMA	National Electrical Manufacturers Association 1300 N 17th St., Suite 1847 Rosslyn, VA 22209 www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association P.O. Box 687 106 Stone St. Morrison, CO 80465-1526 www.electricnet.com/neta	(303) 697-8441
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	(800) 344-3555 (617) 770-3000
NRCA	National Roofing Contractors Association O'Hare International Center 10255 W. Higgins Rd., Suite 600 Rosemont, IL 60018-5607 www.roofonline.org	(800) 323-9545 (847) 299-9070
PDI	Plumbing and Drainage Institute 45 Bristol Dr., Suite 101 South Easton, MA 02375	(800) 589-8956 (508) 230-3516
PGI	PVC Geomembrane Institute P.O. Box 4226 Traverse City, MI 49685 users.aol.com/forPVC1	(616) 933-6373
PPFA	Plastic Pipe and Fittings Association 800 Roosevelt Rd., Building C, Suite 20 Glen Ellyn, IL 60137-5833	(630) 858-6540
PPI	Plastic Pipe Institute (The Society of the Plastics Industry, Inc.) 1801 K St., NW, Suite 600L Washington, DC 20006 www.plasticpipe.org	(202) 974-5306
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association, Inc. 4201 Lafayette Center Dr. P.O. Box 221230 Chantilly, VA 20151-1209 www.smacna.org	(703) 803-2980
UL	Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062 www.ul.com	(800) 704-4050 (847) 272-8800

- G. Federal Government Agencies: Names and titles of Federal Government standards- or specification-producing agencies are often abbreviated. The following abbreviations and acronyms referenced in the Contract Documents indicate names of standards- or specification-producing agencies of the Federal Government. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

CFR	Code of Federal Regulations (Available from the Government Printing Office) Washington, DC 20401 (Material is usually published first in the "Federal Register.") www.access.gpo.gov	(202) 512-0000
DOC	Department of Commerce 14th St. and Constitution Ave., NW Washington, DC 20230	(202) 482-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	(202) 366-4000
EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460	(202) 260-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Ave., SW Washington, DC 20591	(202) 366-4000
FCC	Federal Communications Commission 1919 M St., NW Washington, DC 20554	(202) 418-0126
FDA	Food and Drug Administration 5600 Fishers Lane Rockville, MD 20857	(301) 443-1544
FHA	Federal Housing Administration (U.S. Department of Housing and Urban Development) 451 Seventh St., SW Washington, DC 20410	(202) 401-0388
GSA	General Services Administration F St. and 18th St., NW Washington, DC 20405	(202) 708-5082
MIL	Military Standardization Documents (U.S. Department of Defense) Defense Printing Service 700 Robbins Ave., Building 4D Philadelphia, PA 19111	(215) 697-2179

NIST	National Institute of Standards and Technology (U.S. Department of Commerce) Building 101, #A1134, Rte. I-270 and Quince Orchard Rd. Gaithersburg, MD 20899	(301) 975-2000
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) 200 Constitution Ave., NW Washington, DC 20210	(202) 219-8148

1.5 GOVERNING REGULATIONS AND AUTHORITIES

- A. Copies of Regulations: Obtain copies of the following regulations and retain at the Project site to be available for reference by parties who have a reasonable need:

1.6 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 014200

SECTION 014500 - QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Engineer.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.
 - 2. Division 1 Section "Submittals" specifies requirements for development of a schedule of required tests and inspections.

1.3 RESPONSIBILITIES

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.
 - 1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.

2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
 3. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will engage the services of a qualified independent testing agency to perform those services. Payment for these services will be made from the Inspection and Testing Allowance, as authorized by Change Orders.
 - a. Where the Owner has engaged a testing agency for testing and inspecting part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless agreed to in writing by the Owner.
- B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.
- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
1. Provide access to the Work.
 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 4. Provide facilities for storage and curing of test samples.
 5. Deliver samples to testing laboratories.
 6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 7. Provide security and protection of samples and test equipment at the Project Site.
- D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Engineer and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
1. The agency shall notify the Engineer and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 3. The agency shall not perform any duties of the Contractor.
- E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.4 SUBMITTALS

- A. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Engineer. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.
1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.
1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 014500

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for cutting and patching.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Coordination" for procedures for coordinating cutting and patching with other construction activities.
 - 2. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures well in advance of the time cutting and patching will be performed if the Owner requires approval of these procedures before proceeding. Request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
 - 2. Describe anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms or entities that will perform Work.
 - 4. Indicate dates when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
 - 6. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure.
 - 7. Approval by the Engineer to proceed with cutting and patching does not waive the Engineer's right to later require complete removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Foundation construction.
 - b. Bearing and retaining walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Timber and primary wood framing.
 - g. Structural decking.
 - h. Stair systems.
 - i. Miscellaneous structural metals.
 - j. Exterior curtain-wall construction.
 - k. Equipment supports.
 - l. Piping, ductwork, vessels, and equipment.
 - m. Structural systems of special construction in Division 13 Sections.
- B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.
1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Fire protection systems.
 - f. Noise and vibration control elements and systems.
 - g. Control systems.
 - h. Communication systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction in Division 13 Sections.
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner.
1. If possible retain the original Installer or fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original Installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched-veneer woodwork.

- e. Preformed metal panels.
- f. Firestopping.
- g. Window wall system.
- h. Stucco and ornamental plaster.
- i. Acoustical ceilings.
- j. Terrazzo.
- k. Finished wood flooring.
- l. Fluid-applied flooring.
- m. Carpeting.
- n. Aggregate wall coating.
- o. Wall covering.
- p. Swimming pool finishes.
- q. HVAC enclosures, cabinets, or covers.

1.5 WARRANTY

- A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.
- B. Plaster: Comply with ASTM C 842.
 - 1. Base Coat: Ready-mixed, sand aggregate gypsum plaster base.
 - 2. Finish Coat: Ready-mixed gypsum finish plaster.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.
 - 1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.

- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or re-located until provisions have been made to bypass them.

3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.
 - 1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
 - 4. Comply with requirements of applicable Division 2 Sections where cutting and patching requires excavating and backfilling.
 - 5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
 - 1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 - 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
 - 4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

- D. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.
1. Unless otherwise indicated, provide 3-coat work.
 2. Finish gypsum plaster to match existing adjacent surfaces. Sand lightly to remove trowel marks and arises.
 3. Cut, patch, point-up, and repair plaster to accommodate other construction.
- E. General
1. Execute Work by methods which will avoid damage to other Work, and provide proper surfaces to receive patching and finishing.
 2. Employ skilled and experienced installer to perform cutting and patching.
 3. Employ qualified installer to perform cutting and patching for weather exposed and moisture resistant elements, and sight exposed surfaces.
 4. Cut rigid materials using approved saw or core drill. Pneumatic impact tools not allowed without prior approval.
 5. Restore Work with new products, as required for original installation, and in accordance with requirements of Contract Documents.
 6. Fit Work tight to adjacent elements and around penetrating elements.
 7. Maintain integrity of wall, ceiling, or floor construction; completely seal voids and replace materials removed for testing.
 8. At penetrations of fire rated assemblies, completely seal voids with fire rated material to full thickness of penetrated element.
 9. Refinish surfaces to match adjacent finished. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
 10. Patch or replace portions of existing surfaces which are damaged, lifted, discolored or showing other imperfections.

3.4 CLEANING

- A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 017329

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

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:

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

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.

END OF SECTION 01 74 19

SECTION 017700 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Operation and maintenance manual submittal.
 - 4. Submittal of warranties.
 - 5. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 1 and 26.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 - a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - b. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - 2. Advise the Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Submit record drawings, maintenance manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra stock, and similar items.
 - 7. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.

9. Complete final cleanup requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred, exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat inspection when requested and assured that the Work is substantially complete.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Engineer.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the Owner took possession of and assumed responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit a final liquidated damages settlement statement.
7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Reinspection Procedure: The Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Engineer.

1. Upon completion of reinspection, the Engineer will prepare a certificate of final acceptance. If the Work is incomplete, the Engineer will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated.

1.5 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for the Engineer's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work.
 2. Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.
 3. Note related change-order numbers where applicable.
 4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
- C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction.
1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
 2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
 3. Note related record drawing information and Product Data.
 4. Upon completion of the Work, submit record Specifications to the Engineer for the Owner's records.
- D. Record Product Data: Maintain one copy of each Product Data submittal. Note related Change Orders and markup of record drawings and Specifications.
1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit complete set of record Product Data to the Engineer for the Owner's records.
- E. Record Sample Submitted: Immediately prior to Substantial Completion, the Contractor shall meet with the Engineer and the Owner's personnel at the Project Site to determine which Samples are to be transmitted to the Owner for record purposes. Comply with the Owner's instructions regarding delivery to the Owner's Sample storage area.
- F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Engineer for the Owner's records.
- G. Maintenance Manuals: Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch, 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:
1. Emergency instructions.
 2. Spare parts list.
 3. Copies of warranties.
 4. Wiring diagrams.
 5. Recommended "turn-around" cycles.
 6. Inspection procedures.
 7. Shop Drawings and Product Data.
 8. Fixture lamping schedule.

H. Format:

1. Submit all required closeout documents as noted above, and also compiled onto a CD complete with file directory.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

- B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Startup.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 FINAL CLEANING

- A. General: The General Conditions require general cleaning during construction.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
 - a. Remove labels that are not permanent labels.

- b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
 - d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
 - e. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.
- C. Pest Control: N/A
- D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.
- 1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.

END OF SECTION 017700

SECTION 017836 – WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Submittals" specifies procedures for submitting warranties.
 - 2. Division 1 Section "Contract Closeout" specifies contract closeout procedures.
 - 3. Division 1 Section for specific requirements for warranties on products and installations specified to be warranted.
 - 4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- D. Separate Prime Contracts: Each prime contractor is responsible for warranties related to its own contract.

1.3 DEFINITIONS

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

- A. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
 - 1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within 15 days of completion of that designated portion of the Work.
- B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Engineer, for approval prior to final execution.
- C. Form of Submittal: At Final Completion compile two (2) copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

- D. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch** paper.
1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
 2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.
 3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF WARRANTIES

1. Schedule: Provide warranties on products and installations as specified in equipment schedules on the drawings.
2. Provide warranties as specified in roofing specs.

END OF SECTION 017836

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
- 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
- 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
- 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
- M. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 2nd edition, Chapter 3 - Indoor air quality measures during construction: www.smacna.org
- N. Scientific Certification Systems Global Services – Indoor Advantage Gold certification for furniture, finishes and interior building materials – www.scsglobalservices.com
- O. Collaborative for High Performance Schools – CHPS National Core Criteria for school design and operations: 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

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

	Maximum VOC Level
Welding and Installation	
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
Substrate Specific Applications	
Metal to metal	30
Plastic Foams	50
Porous Material (except wood)	50
Wood	30
Fiberglass	80
Sealants	
Architectural	250
Marine Deck	760
Nonmembrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420
Sealant Primers	
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:

Coatings	Maximum VOC Level (g/L)
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:

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

END OF SECTION 01 81 13



AUSTIN ISD SUSTAINABILITY SCORECARD

19-0040-OHNR - RENOVATIONS AT O'HENRY MS

018113 Appendix A - AISD Sustainability Scorecard

Y	N	?	Mandatory Requirements	
Y			ALL 1M	Basis of Design Document: AE to prepare narrative at SD and update
Y			ALL 2M	Design Review Process: Sustainability Review at SD, DD, CD
Y			ALL 3Ma	Low Emitting Materials - Adhesives, Sealants, Paints + Coatings: Low VOC
Y			ALL 3Mb	Low Emitting Materials - Composite wood and agrifiber: No added formaldehyde
Y			ALL 3Mc	Low Emitting Materials - Flooring: Green Label Plus, FloorScore
Y			ALL 3Md	Low Emitting Materials - Insulation (batt): No added formaldehyde
Y			ALL 3Me	Low Emitting Materials - Wall and Ceiling Systems: Must be SCS indoor Advantage Gold or Greenguard Gold Certified
Y			ALL 4M	Construction Waste Management: Divert 75% from landfill
Y			ALL 5M	IAQ During Construction: Provide IAQ plan
Y			M1M	Energy Efficiency - Mechanical Renovation: 10%>ASHRAE 90.1-2010
Y			M2M	Commissioning - Mechanical: Reference AISD standard spec
Y			E1M	Energy Efficiency - Lighting: 15>ASHRAE 90.1-2010
Y			E2M	Commissioning - Electrical: Reference AISD standard spec
Y			P1M	Indoor Water Use Reduction: Use 5% less water than CoA code
Y			P2M	Commissioning - Plumbing: Reference AISD standard spec
	NA		ARCH 1M	Storage & Collection of Recyclables & Compostables
	NA		ARCH 2M	Energy Efficiency - Envelope: Part 5 of ASHRAE 90.1-2010
	NA		ARCH 3M	Acoustical Performance-1: ASHRAE handbook Chpt 48
	NA		ARCH 4M	Acoustical Performance-2: Ceiling Tiles w/ NRC of 0.70 or better
	NA		ARCH 5M	Acoustical Performance-3: Isolate learning spaces in compliance with ANSI S12-2010
	NA		SITE 1M	Native and Non-Invasive Adapted Species
	NA		SITE 2M	Outdoor Water Use Reduction - 30%: Document 30% reduction
	NA		SITE 3M	Integrated Pest Management: Refer to AISD standard spec

NOTE: This score card is an appendix to 01 81 13 Sustainable Construction Requirements. Not all mandatory items are applicable to all project types. The AISD PM & 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.

Y	N	?	Voluntary Requirements	
Y			ALL 1V	Optimize Energy Performance: 6% improvement over baseline
N			ALL 2V	Construction Waste Management: 95% diversion from landfill
N			ALL 3V	Sustainably Sourced Materials and Products: 20% of construction cost to be regionally sourced, contain recycled content, FSC certified wood
N			ALL 4V	School As a Teaching Tool: Educate building occupants w/ signage, case study published on district website, digital presentations.
N			M1V	Enhanced Refrigerant Management: No refrigerants
N			M2V	Controllability of Systems - Thermal Comfort: Occupant controls
N			M3V	Indoor Chemical and Pollutant Control: Walk-off mats, separate ventilation, MERV13 filters
N			E1V	Renewable Energy: Offset 1 to 10% of building energy cost.
N			E2V	Controllability of Lighting Systems: Occupant controls
N			E3V	Daylight Controls: Sensors
N	?		P1V	Indoor Water Use Reduction: Use 10% less water than CoA code
N			P2V	Process Water Reduction: Comply w/ AISD process water tracking matrix
N			ARCH 1V	Envelope Commissioning - Additions & Major Renovations: Cx of envelope to comply with NIBS 3-2012
N			ARCH 2V	Views to Outside: Provide 75% of occupied spaces with views
N			ARCH 3V	Daylighting: Provide 70% of occupied spaces with daylighting
N			ARCH 4V	Low Emitting Materials - Furniture and Furnishings: Meet CA 01350 as verified by GREENGUARD Gold Standard or SCS Indoor Advantage Gold
N			ARCH 5V	Moisture Protection: Install no vinyl or plastic laminate wall coverings or other fiber reinforced plastic or vinyl as the finish material
N			ARCH 6V	Low Emitting Materials - Insulation (non-batt): no added formaldehyde
N			ARCH 7aV	Construction IAQ Mgmt Before Occupancy, Air Testing: Conduct IAQ testing according to AISD IAQ Testing Standards and Methods Table.
N			ARCH 7bV	Construction IAQ Mgmt Before Occupancy, Flush Out: Install new filters and supply 14,000 cu.ft of outdoor air per SF
N			SITE 1V	Protect and Restore Habitat: Restore 30% or more
N			SITE 2V	Maximize the Open Space: Provide open space equal to 30% of site
N			SITE 3V	Stormwater Design Quality: Manage a volume of stormwater equal to 50% of water quality volume (WQV) by infiltration on site.
N			SITE 4V	Site Assessment: Design narrative
N			SITE 5V	Outdoor Water Use reduction: 50% reduction or no potable water
N			SITE 6V	Parking Capacity: Reduce parking by min. of 20% above code
N			SITE 7V	Carpools, vanpools, LEV & FEV: Provide 5% preferred parking for car/van pools and low emitting/ fuel efficient vehicles.
N			SITE 8V	Reduce Heat Island Effect: Green roof for 25% or shading 50% hardscape or 50% hardscape with SRI >29
N			SITE 9V	Light Pollution Reduction: Meet requirements for uplighting and light trespass
N			SITE 10V	Learning Environment: Outdoor classroom

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

THIS SECTION NOT REQUIRED UNLESS PERSUING VOLUNTARY MEASURE ALL3V - SUSTAINABLY SOURCED MATERIALS

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 01 91 13**GENERAL COMMISSIONING REQUIREMENTS**

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 general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Division 22 Section "Commissioning of Plumbing Systems" for commissioning process activities for plumbing systems, assemblies, equipment and components.
 - 2. Division 23 Section "Commissioning of Mechanical Systems" for commissioning process activities for mechanical systems, assemblies, equipment, and components.
 - 3. Division 23 Section "Commissioning of Building Automation Systems" for commissioning process activities for control systems.
 - 4. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.

1.3 DEFINITIONS

- A. Approval: Acceptance that a piece of equipment or system has been properly installed and is functioning in tested modes according to Contract Documents.
- B. Basis of Design (**BoD**): A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process. Describes systems, components, conditions, and methods chosen to meet design intent.
- C. Building Commissioning: A joint team effort to ensure that all mechanical equipment, controls, and systems function together properly to meet the design intent, to document system performance parameters for fine-tuning of control sequences and operational procedures, and to ensure that personnel are adequately trained to operate systems.
- D. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

- E. Commissioning Authority (**CxA**): Independent agent hired by Owner and not associated with Contractor or its subcontractors, Architect or its sub-consultants, or Owner's Contracting Officer Technical Representative or its staff or consultants. Under Owner's direction, and not Contractor's direction, CA will direct and coordinate day-to-day commissioning activities without assuming oversight responsibilities.
- F. Commissioning (**Cx**) Process: A process that encompasses and coordinates the traditionally separate functions of system documentation, equipment start-up, control system calibration, testing and balancing, training and performance testing. Commissioning requirements do not supersede other requirements of the specifications, but may expand on some of them.
- G. Commissioning Team: Consists of a Commissioning Authority retained by the Owner, Owner's Representative, major equipment suppliers and Contractors/subcontractors.
- H. Contractor (**GC**): Representatives from the general contractor, with whom Owner is contractually obligated to carry out overall planning, coordination, and control of project from inception to completion in accordance with contract documents.
- I. Deferred Functional Tests: Functional tests performed later, after Substantial Completion, due to partial occupancy, equipment, seasonal requirements, design, or other Site conditions that disallow test from being performed.
- J. Design Intent: Dynamic document that provides explanation of ideas, concepts, and criteria that are considered to be important to Owner. Initially, outcome of programming and conceptual design phases.
- K. Design Team: Representatives from the Architect's and/or Engineer's office responsible for the design and contract administration of the project.
- L. Functional Test: Test of dynamic function of systems, as opposed to components, under full operation in various modes through all control system's sequences of operation using manual (direct observation) or monitoring methods following prescribed test procedures in sequential written form.
- M. Owner's Project Requirements (**OPR**): A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- N. Pre-functional Checklist: List, provided by Commissioning Authority to installer, of items to inspect and elementary component tests to conduct to verify proper installation of equipment prior to functional testing.
- O. Sampling: Functionally testing only a fraction of total number of identical or near identical pieces of equipment.
- P. Seasonal Commissioning: Testing of equipment that can be done only during periods of peak heating or cooling, when HVAC equipment is operating at full-load or heavy-load conditions.
- Q. Simulated Condition: Condition created for purpose of testing response of system.

- R. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- S. Trending: Monitoring using building control system.

1.4 COMMISSIONING TEAM

- A. Members Appointed by GC: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of GC, including Project superintendent and all subcontractors, installers, suppliers, specialists, etc. who are responsible for installing systems under this project.
- B. Members Appointed by Owner:
 - 1. Owner's Project Manager;
Department of Construction Management
Austin Independent School District
812 San Antonio, Suite 200
Austin, Texas 78701
Phone: 512-414-8940
 - 2. Owner's Service Center Personnel:
Mechanical Supervisor
Electrical Supervisor
Plumbing Supervisor
Energy Management Dept.
 - 3. Commissioning Authority (CxA):
ACR Engineering, Inc.
3001 S. Lamar Blvd, Suite 210
Austin, TX 78704
Contact: Ricardo Troncoso
Phone (office): 512-440-8333
Phone (mobile): 512-563-3493
E-mail: rtroncoso@acreng.com
 - 4. Architect:
Project Specific
 - 5. MEP Engineer:
Project Specific
 - 6. General Contractor/Construction Manager at Risk:
Project Specific

1.5 RESPONSIBILITIES

- A. Responsibilities of the CxA during the Construction Phase include, but are not limited to the following:
1. Review submittals for equipment & systems to be commissioned. Issue comments to Owner and Design Team.
 2. Review Facility Automation System (FAS) submittals and participate in review meeting with Owner, Design Team and GC.
 3. Prepare project-specific pre-functional/installation checklists and deliver to GC.
 4. Field-verify pre-functional/installation checklists completed by Contractor.
 5. Document and track resolution of installation deficiencies via a Commissioning Log.
 6. Participate in point-to-point third-party verification of HVAC controls.
 7. Participate in third-party sequence testing/verification of HVAC controls.
 8. Verify that GC has delivered O&M's and as-built drawings related to commissioned systems.
 9. Document and track resolution of controls systems deficiencies via a Commissioning Issues Log.
 10. Upon Owner request, assist in the resolution of issues related to commissioned systems.
 11. Prepare a Summary Commissioning Report outlining systems commissioned, findings and resolutions.
- B. Contractor: Responsibilities of the Contractor (GC) as related to Commissioning Process include, but are not limited to the following:
1. Provide to CxA copies of submittals for all systems to be commissioned.
 2. Schedule and facilitate submittal review meeting for Facility Automation System / HVAC Controls.
 3. Manage distribution of pre-functional/installation checklists to sub-contractors.
 4. Require sub-contractors to complete pre-functional/installation checklists.
 5. Verify completion of pre-functional/installation checklists by sub-contractors.
 6. Request field-verification of completed pre-functional checklists by CxA.
 7. Provide written notification to CxA that all aspects of controls work are complete in accordance with specifications.
 8. Provide as-built controls O&M documentation to Owner, Design Team, and CxA.
 9. Coordinate participation of qualified sub-contractor personnel in third-party point-to-point testing of controls.
 10. Coordinate participation of qualified sub-contractor personnel in third-party sequence testing of controls.
 11. Coordinate correction of deficiencies identified in Cx Log as directed by Design Team.
 12. Provide written notification to CxA when all items on the Cx Log have been corrected as directed by Design team.
 13. Coordinate sub-contractor participation in verification of correction to items on Cx Log.
 14. Provide O&M and as-built documentation for all commissioned systems –including TAB report when required.
 15. All costs associated with the participation of GC, Sub-Contractors, Design Professionals, and Equipment Vendors in the Commissioning Process shall be included as part of the Construction Contract.

- C. Owner's Representative: Responsibilities of the Owner's Representative as relate to Commissioning Process include, but are not limited to the following:
1. Manage contracts of Architect/Engineer, CxA and GC.
 2. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
 3. Provide final approval for completion of commissioning Work.
 4. Warranty Period: Ensure that seasonal or deferred testing and deficiency issues are addressed.
- D. Design Team: Responsibilities of the Design Team as related to the Construction Phase Commissioning Process include, but are not limited to the following:
1. Perform normal submittal review, construction observation, record drawing preparation, and operations and maintenance data preparation, as required by Contract Documents.
 2. Review Commissioning Authority's submittal review comments and issue directive to GC and/or Design Professionals as deemed applicable.
 3. Coordinate resolution of system deficiencies identified during commissioning, as required by Contract Documents. Review Commissioning Issues Logs and issue directives to GC and/or Design Professionals as applicable.
 4. Assist, along with GC, in clarifying operation and control of commissioned equipment in areas where specifications, control drawings, or equipment documentation are not sufficient for writing detailed testing procedures.
 5. Prepare and submit final as-built design intent documentation for inclusion in Operation and Maintenance Data Manual, and review and approve Operation and Maintenance Data Manual.
 6. Review Commissioning Report and issue directive to resolve all outstanding deficiencies prior to project close-out.
 7. Warranty Period: Coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

A. Authority

1. The Commissioning Authority carries out his responsibilities as the Owner's authorized agent in accordance with plans, specifications, and contractual requirements.
2. CxA reports deficiencies found to the GC, Design Team and Owner.
3. The Design Team evaluates deficiencies and issues directive to GC to remedy CxA's deficiencies lists, in accordance with contract documents.
4. No change in scope work is to take place without express written consent of Owner. Any deficiencies identified by CxA that are deemed by Design Team to be outside of the scope of work shall be discussed with Owner for consideration.
5. GC and CxA are to copy Architect on all correspondence related to the commissioning process.

B. Participation In The Commissioning Process

1. GC shall attend meetings related to Commissioning process and arrange for attendance by subcontractors and vendors prior to commissioning of their systems, at the discretion of CxA.
2. Provide skilled technicians to start and test all systems, and place systems in complete and fully functioning service in accordance with contract documents and design intent.
3. Provide skilled technicians, experienced and familiar with systems being commissioned, to assist CxA in commissioning process.
4. Participate in field-verification of pre-functional checklists with subcontractor and CxA.
5. Coordinate with sub-Contractors and equipment vendors/representatives to set aside adequate time to address Pre-Functional Checklists, Functional Testing, Operations and Maintenance Training, and associated coordination meetings.

C. Work Prior To Testing

1. Upon completion of submittal review, CxA shall issue pre-functional/installation checklists for review by GC and subcontractors. GC and sub-contractors shall review checklists applicable to their specific systems and requests clarifications from CxA.
2. If deemed necessary (and at CxA's option) a pre-commissioning meeting will be scheduled to review the commissioning process and checklists with GC, sub-contractors, Owner, and Design Team.
3. Prior to pre-functional and functional testing, CxA will conduct site inspections at critical times and issue Cx Field Reports with observations on installation deficiencies so that they may be addressed by Design Team as deemed appropriate
4. GC shall complete all phases of the work so the systems can be started, tested, adjusted, balanced, and otherwise commissioned.
5. GC shall verify requirements of Divisions 22, 23 and 26 outlining responsibilities for start-up of equipment with obligations to complete systems, including all sub-systems so that they are fully functional.
6. A minimum of seven (7) days prior to equipment start-up GC shall notify CxA of proposed start-up date. CxA may elect to witness start-up of equipment. Witnessing of normal manufacturer start-up by CxA does not replace third-party commissioning activities.

D. Pre-functional checks and functional performance tests

1. The GC shall provide all materials, services, and labor required to operate equipment and/or system in order to perform the pre-functional checks and functional performance tests. A pre-functional check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating commissioning team member of which participation is specified is not present for the test. The GC shall reimburse the Owner and A/E for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable).
2. Functional performance tests may sometimes duplicate the checking, testing, and inspection methods established in related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide required information. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are

independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section without the approval of CxA.

3. Follow start-up and initial checkout procedures listed in article titled "RESPONSIBILITIES" in Part 1, and additional requirements specified in this Section. Divisions 22, 23 and 26 have startup responsibilities and are required to complete systems and sub-systems so systems are fully functional, meeting design requirements of Contract Documents. Commissioning procedures and functional testing do not relieve or lessen this responsibility or shift this responsibility, in whole or in part, to Commissioning Agent or Owner.

E. Work To Resolve Deficiencies

1. Complete corrective work in a timely manner to allow expeditious completion of commissioning process. If deadlines pass without resolution of identified problems, Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs thus incurred will be GC's responsibility.

3.2 LEED PROGRAM REQUIREMENTS

- A. This project will be NOT be rated under the LEED™ rating system. .

3.3 PRE-FUNCTIONAL CHECKLISTS

A. General

1. Pre-functional checklists are used as a tool to ensure and document that equipment and systems are properly connected and operational, and installed in accordance with specifications, drawings, manufacturer's requirements, and all applicable codes.
2. Checklists ensure that functional performance testing (in-depth checkout) may proceed without unnecessary delays.
3. Performance of pre-functional checklists, startup, and checkout shall be directed and executed by subcontractor or vendor. Only individuals that have direct knowledge and who witnessed that line item task on pre-functional checklist was performed shall initial or check item off.
4. Each piece of equipment and major distribution system receives full pre-functional checkout. No sampling strategies are used.
5. Pre-functional checkout for given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of given system.

B. Pre-functional Checklists

1. Pre-functional performance tests shall be documented in a checklist format, as prepared and provided by CxA, for each piece of equipment. Each checklist shall be initialed by GC, verifying that all items on checklist have been addressed and completed.
2. Commissioning Pre-functional checklists are not to preclude GC from applying his own construction inspection checklists.
3. All system elements shall be checked to verify that they have been installed, adjusted, and calibrated properly, that all connections have been made correctly, and that it is ready to function as specified. Verify that each piece of equipment or system has been checked for

proper lubrication, drive rotation, control sequence, and other conditions which may cause damage.

4. Verify that tests, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.
5. All discrete elements and sub-systems shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.
6. CxA third-party verification of pre-functional checklists will NOT take place at the time as equipment start-up or contractor's checklist verification.
7. Do not place equipment or system in continuous operation prior to pre-functional testing verification by CxA.
8. When pre-functional checklists for a particular system or subsystems are completed, GC will request verification by CxA. GC and subcontractors shall accompany CxA during pre-functional checklist verification.
9. If during pre-functional checklist verification, CxA finds a significant number of deficiencies, GC shall have all the checklists associated with similar system redone.

3.4 SYSTEM START-UP

- A. GC will arrange for start-up of operating equipment and systems after (or at the same time as) pre-functional testing and prior to scheduling pre-functional checklist verification by CxA.
- B. Start-up of equipment and systems shall be performed only by a manufacturer's representative, or person(s) who are specifically manufacturer-approved. All start-up personnel shall be trained and authorized, experienced and knowledgeable in the operations of such equipment and systems.
- C. Coordinate schedule for start-up of various equipment and systems so that subsystems required for major systems operation are tested first.
- D. Manufacturer's start-up reports must be submitted to CxA prior to scheduling third-party pre-functional checklist verifications.

3.5 FUNCTIONAL TESTING

- A. The objective of Functional Testing is to demonstrate that each system is operating according to documented design intent and Contract Documents, through all possible modes of operation.
- B. GC and sub-Contractors shall include in bid proposal all costs associated with preparation and execution of Testing Procedures for all systems to be commissioned.
- C. Functional testing is intended to begin upon completion of each system and after pre-functional checklists have been completed. Functional testing may proceed prior to completion of systems or sub-systems at discretion of Commissioning Authority. Beginning system testing before completion does not relieve GC from fully completing system, including pre-functional checklists as early as possible.
- D. GC and sub-Contractors shall provide detailed Testing Procedures that will allow all items on checklists to be verified.

- E. Testing shall be conducted under specified operating conditions as recommended or approved by Commissioning Authority.
- F. A Functional Performance Test shall be performed on each complete system. Each function shall be demonstrated to the satisfaction of Commissioning Authority in accordance with proposed test procedures developed to demonstrate compliance with specifications.
- G. Each Functional Test shall be witnessed and signed off by Commissioning Authority upon satisfactory completion. Functional Test is not to be considered complete until Owner accepts Commissioning Authority's recommendation for completion.
- H. All elements of system shall be tested to demonstrate that total systems satisfy all requirements of these specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by the entire system, followed by any inter-ties to other major systems.
- I. Notification, Scheduling Of Functional Testing and Re-Testing
 - 1. Notify CxA and Owner, in writing, of request for scheduling Functional Testing. Submit request no fewer than five days prior to desired date for beginning functional testing.
 - a. GC must certify that systems and equipment are functioning satisfactorily, according to specifications and design intent, prior to requesting Functional Testing. Upon receipt of such certification, CxA will schedule with GC a time for the particular system test.
 - 1) CxA will attempt to schedule Functional Testing when convenient for GC and his vendors, and to minimize lost time to GC.
 - b. GC will resolve all deficiencies identified during initial test prior to submitting request, in writing, for re-testing. Such request for re-testing shall certify that GC has resolved all deficiencies, or list reason why any deficiencies remain which cannot be resolved.
 - c. CxA will re-test to ensure that all deficiencies have been resolved.
 - 1) Deficiencies that were not detected in first Functional Test, but are discovered in subsequent re-testing, are to be resolved by GC as if they had been discovered in initial testing.
- J. Functional Testing Requirements And Procedures
 - 1. GC and sub-Contractors shall perform tests in the presence of CxA. Tests not witnessed by CxA shall not be considered complete.
 - 2. To facilitate Functional Testing, when requested by CxA, GC shall provide services of personnel to accompany CxA for the duration of Functional Testing, including any follow-up testing. Such personnel must be experienced, qualified, and intimately familiar with the system being tested.

- a. Participation by representative(s) of direct digital controls (DDC) systems is of particular importance in Functional Testing. All systems which are controlled and/or monitored by DDC are to be thoroughly tested, point by point, through all modes of operation, with the assistance of manufacturer's representative. DDC graphics, setpoints, and programming are to be included as a part of Functional Testing as well.
 - b. GC must provide services of personnel to accompany CxA for equipment and systems which may pose particular health and safety concerns, such as boilers.
 - c. Should he fail to provide representative to accompany CxA during Functional Testing, GC continues to bear full responsibility for equipment warranty. Owner and CxA will not be held responsible for damage to equipment, or other actions which might impact warranty, when performing Functional Testing of systems where GC has not provided authorized accompanying representative to operate equipment.
3. Each system shall be operated through all modes of operation including, but not limited to seasonal, occupied, unoccupied, warm-up, cool-down, part-load, and full-load, where system response is specified.
 - a. For multiple units, sampling strategy established by Commissioning Authority and subject to approval of Owner may be used.
 - b. Verification of each sequence in sequences of operation is required.
 - c. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, and the like, shall also be tested.
 4. Where possible, inspections carried out on systems by local Authorities Having Jurisdiction (AHJ) may serve as Functional Testing for purposes of Commissioning.
 - a. CxA will accompany AHJ during testing procedures required by AHJ.
 - b. It is responsibility of GC to arrange for testing by AHJ and to coordinate with CxA to find mutually convenient times for testing. Provide CxA a minimum of four days in advance of intent to schedule testing by AHJ.
 - c. CxA will issue a separate report on results of testing.
 - d. CxA reserves the right to require additional testing, should testing by AHJ not adequately cover all system components in all modes of operation.
 5. Functional Testing is to be dedicated solely to testing of equipment and systems, and not to resolution of deficiencies. Deficiencies identified during testing process must be corrected by GC at a time other than during Functional Testing.
 6. Within six days of performing functional test, CxA will issue test report with findings a list of deficiencies that must be addressed by GC or sub-Contractors.
 7. Commissioning Authority shall submit a Final Report to Owner recommending acceptance or non-acceptance of individual system components as well as the systems as a whole.

K. Re-Testing And Failure To Remedy Deficiencies

1. Despite GC's best efforts to ensure systems are problem-free, it is expected that some deficiencies will be found during initial inspection of Pre-functional Checklist, and during initial Functional Testing; such deficiencies are expected to be minimal.
2. It is GC's responsibility to remedy identified deficiencies, both in Pre-functional Checklist and in Functional Testing phases of work, in a timely and thorough manner.

3. It is GC's responsibility to ensure that all deficiencies are corrected prior to requesting a re-inspection or re-test of systems and equipment. Do not request re-inspection or re-test until deficiencies are corrected.
 - a. At his discretion, CxA may agree to re-testing systems or equipment where deficiencies remain which are beyond GC's control to resolve expeditiously.
 - b. Typically such re-testing of incomplete systems and equipment will take place only if remaining deficiencies are minor in scope and nature, and are of such nature that they cannot be resolved in a timely manner (such as those due to difficulties in obtaining parts, or where Owner has requested a change that has delayed work, etc.)
4. CxA will carry out a second re-inspection or re-test of systems and equipment subsequent to receiving GC's request.
 - a. If CxA finds deficiencies identified in initial inspection or test have not been remedied (with exception of un-resolvable deficiencies in 3.b. above), and such remaining deficiencies are significant enough to require additional inspection or re-testing, GC will be back-charged for CxA's expenses, and time at a rate of \$120 per hour, for a third and any subsequent re-inspections and re-tests.

3.6 DEFERRED TESTING

- A. "Seasonal Commissioning" pertains to testing during peak heating or cooling seasons when HVAC equipment is operating at full-load or heavy-load conditions. Initial commissioning will be done as soon as contract work is completed, regardless of season. Seasonal Commissioning under full- or heavy-load conditions other than the current season will be handled at later time by GC and CxA.
 1. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods.
 2. GC is to provide services of personnel and participate in seasonal testing process in the same manner as he would in non-seasonal testing.
 3. Until off-season commissioning can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of off-season testing.
- B. Unforeseen Deferred Tests: If any check or test cannot be completed due to building structure, required occupancy condition, or other reason, execution of checklists and functional testing may be delayed upon approval of Owner. Tests shall be conducted in same manner as seasonal tests, as soon as possible. Services of required parties will be negotiated. Make final adjustments to Operation and Maintenance Manuals and record drawings due to unforeseen deferred tests.
 1. GC is to provide services of personnel and participate in deferred testing in the same manner as he would for normal commissioning.
 2. Until deferred testing can be accomplished, Owner may retain an amount from GC's payment sufficient to cover the cost of deferred testing.

3.7 TRAINING

- A. The following requirements are in addition to operation and maintenance requirements specified elsewhere in this specifications manual. GC shall be responsible for training coordination and scheduling, and ultimately to ensure that training is completed.
- B. Scheduling
 - 1. Organize training to fit Owner's schedule and to optimize the learning experience. Limit continuous sessions to no more than four hours, or otherwise only as approved by Owner and/or Architect.
 - 2. Provide an outline of the proposed training agenda for review by Owner and CxA a minimum of 10 days prior to proposed date for training session.
 - 3. Provide CxA a minimum 5 days advance notice of intent to carry out a training session.
 - 4. The CxA will not be required to attend all training sessions for building personnel, but will attend selected sessions and monitor progress and content.
 - 5. No training will take place prior to successful completion of Functional Testing.
- C. Training Materials
 - 1. Develop Training Manuals to meet requirements of individual equipment specification sections.
 - 2. Operating and Maintenance Manuals alone are NOT considered training manuals. O&M Manuals may be used as reference, but shall not be considered to meet requirements for training materials.
 - 3. Develop a detailed outline showing how training program will be organized, including classroom and hands-on training as required by individual specifications sections.
 - 4. Provide with training materials, a quick-reference "how-to" index which will allow operators to easily access information included in Training Manuals and/or O&M Manuals. This reference will include, as a minimum; routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions.
 - 5. Refer to individual equipment or system specifications for minimum material to be covered as part of the training program.
- D. Documentation
 - 1. All training sessions are to be fully documented. Document:
 - a. Basic information on training session (name of system, time, date, and location of training, name of presenter, length of training session, etc.).
 - b. Names of persons who attended the training session (provide a sign-in sheet).
 - c. Signature from authorized Owner's representative indicating that training took place and was satisfactory.
 - 2. Provide CxA copy of sign-in sheet with training session documentation.

3.8 O&M MANUALS

- A. Provide operation and maintenance manuals as specified in section 017700 Closeout Submittals, and as outlined in individual sections of Divisions 22, 23 and 26.
- B. Provide CxA with a single copy of Operation and Maintenance Manuals for review. CxA's copy of O&M manuals shall be submitted through Design Team.
- C. CxA shall review O&M Manuals and submit comments through Design Team.

3.9 SYSTEMS TO BE COMMISSIONED

- A. Refer to commissioning specifications sections in Related Sections, including the following:
 - 1. 220100 – COMMISSIONING OF PLUMBING SYSTEMS
 - 2. 230100 - COMMISSIONING OF MECHANICAL SYSTEMS
 - 3. 230926c – COMMISSIONING OF BUILDING AUTOMATION SYSTEMS
 - 4. 260100 - COMMISSIONING OF ELECTRICAL SYSTEMS

END OF SECTION 01 91 13

DIVISION 02

EXISTING CONDITIONS

**028200
ASBESTOS
ABATEMENT**

(by Fercam Group abatement consultants
under separate contract to AISD)



PROJECT MANUAL

For Abatement of Asbestos-Containing Materials:

O'HENRY MIDDLE SCHOOL

2610 West 10th Street
Austin, Texas



Fercam Group

Project No: PROJECT NO. 1810047

Prepared for:

Austin Independent School District

906 W Lynn Street

Austin, Texas 78703

Prepared by:

**FERCAM GROUP
303 E. MAIN STREET
HUMBLE, TX 77338**

Tel: (281) 446-4371 Fax: (281) 446-8061

October 18, 2018

A handwritten signature in blue ink, appearing to read 'FL Flynn'.

License No. 10-5279
10/18/18

PROJECT INFORMATION

SECTION 00010	DIRECTORY.....	1
SECTION 00900	INDEX TO DRAWINGS.....	1
SECTION 01000	SUMMARY OF WORK.....	10

ADMINISTRATIVE PROCEDURES

SECTION 01050	PROJECT COORDINATION.....	2
SECTION 01100	DEFINITIONS AND STANDARDS.....	9
SECTION 01200	CODES AND REGULATIONS.....	4
SECTION 01350	SHOP DRAWINGS, PRODUCT DATA, SAMPLES.....	3
SECTION 01360	SUBSTITUTIONS AND PRODUCT OPTIONS.....	2
SECTION 01370	PRODUCT HANDLING.....	2
SECTION 01380	TEMPORARY FACILITIES.....	6
SECTION 01390	PROJECT CLOSEOUT.....	5

AIR MONITORING / INSPECTION / LABORATORY TESTING SERVICES

SECTION 01400	AIR MONITORING AND INSPECTION/TESTING LABORATORY SVCS..	6
SECTION 01410	FINAL CLEARANCE (AGGRESSIVE PCM).....	2
SECTION 01420	FINAL CLEARANCE (AGGRESSIVE TEM).....	2
SECTION 01430	FINAL CLEARANCE (STATIC PCM).....	2

REMOVAL PROCEDURES

SECTION 01500	TEMPORARY CONTAINMENT.....	7
SECTION 01510	PRE-CLEANING AND DECONTAMINATION PROCEDURES.....	3
SECTION 01520	DECONTAMINATION UNITS.....	8
SECTION 01530	VENTILATION SYSTEM.....	5
SECTION 01540	REMOVAL OF ASBESTOS-CONTAINING MATERIALS.....	4
SECTION 01548	REMOVAL OF MECHANICAL EQUIPMENT INSULATION.....	4
SECTION 01549	REMOVAL OF PIPE INSULATION.....	4
SECTION 01550	REMOVAL OF PIPE INSULATION (GLOVE BAG METHOD).....	4
SECTION 01555	REMOVAL OF PIPE INSULATION IN CRAWL SPACE.....	2
SECTION 01560	REMOVAL OF ASBESTOS CONTAMINATED SOIL.....	2
SECTION 01580	REMOVAL OF TEMPORARY CONTAINMENT.....	3
SECTION 01590	DISPOSAL OF ASBESTOS-CONTAINING WASTE MATERIAL.....	3

PERSONNEL PROTECTION

SECTION 01700	WORKER PROTECTION.....	8
SECTION 01710	RESPIRATORY PROTECTION.....	7



License No. 10-5279

10/18/18

GENERAL CONSTRUCTION

SECTION 02000 DEMOLITION WORK (NON - ACM) 2
SECTION 02050 NON ACM BUILDING DEMOLITION 2
SECTION 15200 REPAIR OF INSULATION AND LAGGING 3



License No. 10-5279

10/18/18



License No. 10-5279
10/18/18

PAGE 1

PROJECT DIRECTORY

SECTION 028200.00010

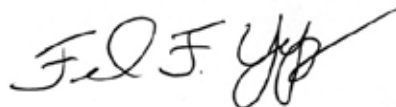
PROJECT NAME: O'Henry Middle School
2610 West 10th Street
Austin, Texas

PROJECT NO: 1810047

OWNER: Austin Independent School District
111 W. 6th Street
Austin, Texas 78703

CONTACT: Rick Kaven, Project Manager
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Fernando F. Yepez
Principal
TDSHS Asbestos Consultant License #10-5279

FLFY

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10/18/18

PAGE 1

INDEX TO DRAWINGS

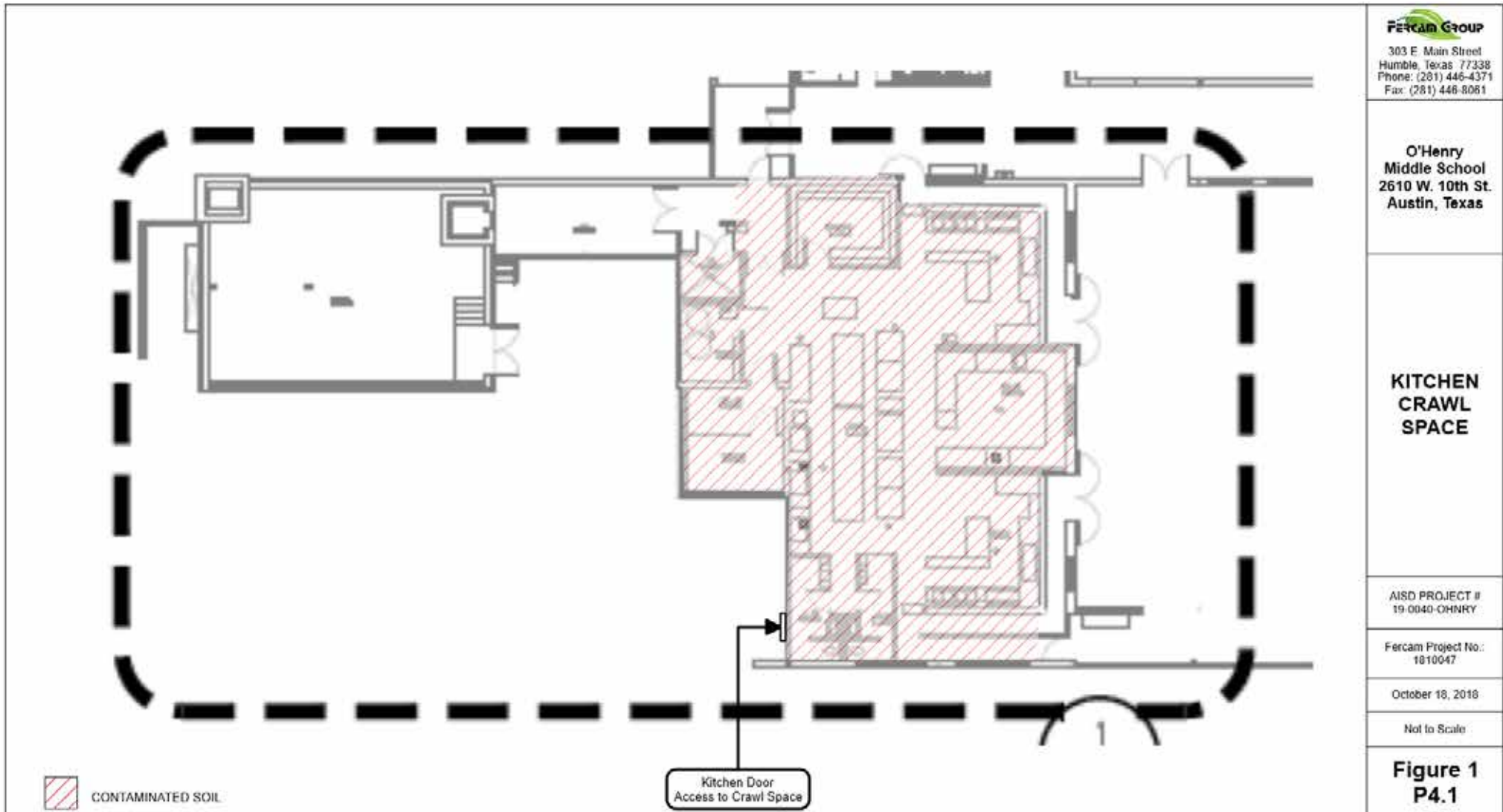
SECTION 028200.00900

<u>DESCRIPTION</u>	<u>DRAWING NO.</u>
KITCHEN CRAWL SPACE.....	P4.1
BOY'S & GIRL'S LOCKER ROOMS.....	P4.2

FLFYA

License No. 10-5279
10/18/18

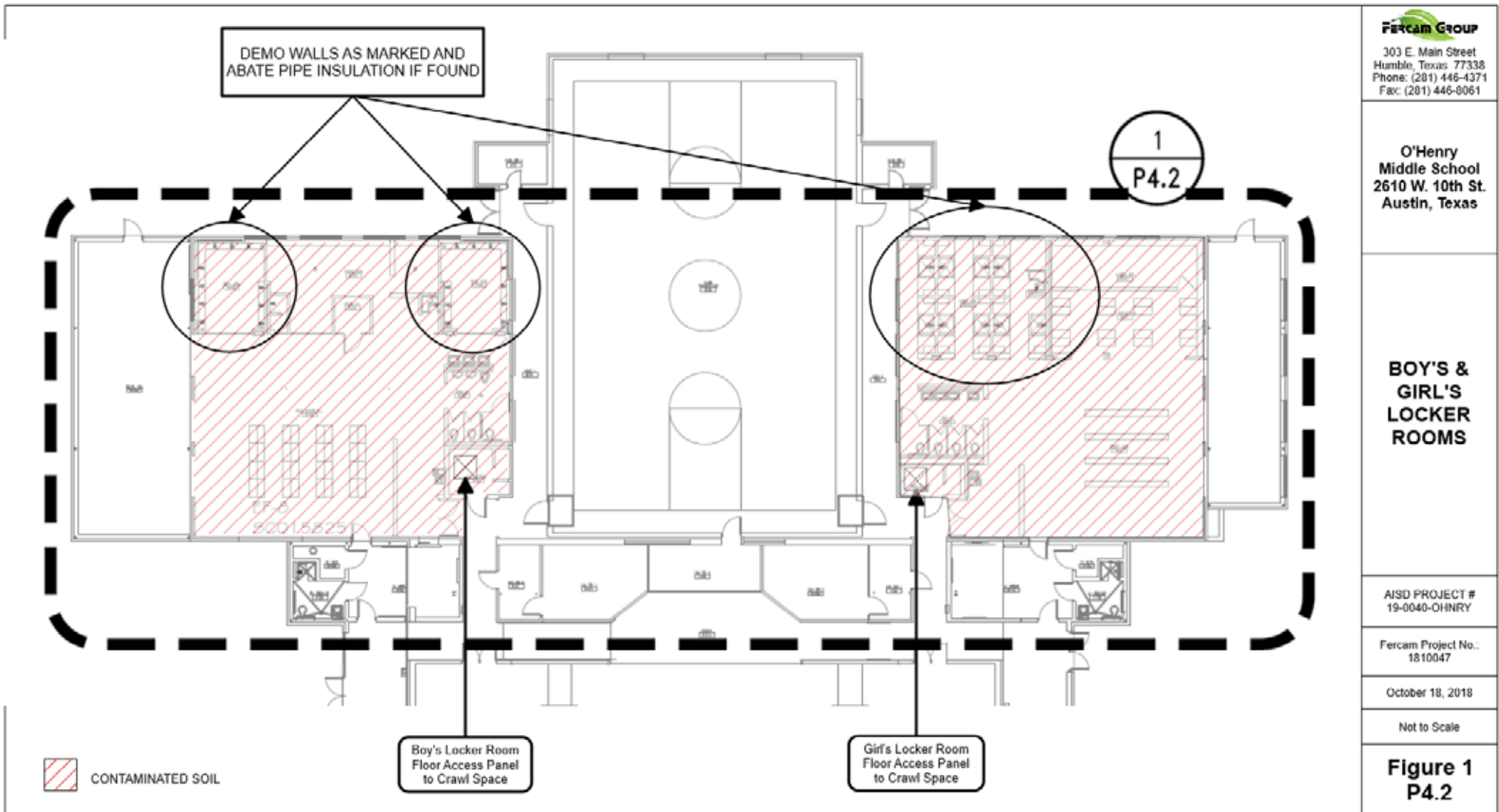
SECTION 028200.00900
DRAWINGS
PAGE 2



PROJECT SPECIFICATION
O'HENRY M.S. - PROJECT NO. 1810047

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License No. 10-5279
10/18/18



PROJECT SPECIFICATION
O'HENRY M.S. - PROJECT NO. 1810047



License No. 10-5279
10/18/18

SUMMARY OF WORK

SECTION 028200 01000

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

CONTRACT DOCUMENTS:

The Contract Documents, as prepared by the **CONSULTANT**, indicate the Work of the Contract and related requirements and conditions that have an impact on the Project. Related requirements and conditions include, but are not necessarily limited to the following:

- Applicable codes and regulations.
- Notices, permits, license fees, taxes.
- Existing site conditions and restrictions on use of site.
- Work performed prior to work under this Contract.
- Alterations and coordination with existing work.
- Work to be performed concurrently by the **OWNER**.
- Work to be performed concurrently by separate contractors.
- Work to be performed subsequent to work under this Contract.
- Requirements for partial **OWNER** occupancy prior to substantial completion of the Contract Work.

PROJECT DURATION:

Base Bid: The Project Duration for the Base Bid shall be as follows:

Maximum consecutive calendar days.....Twenty-One (21) days

Maximum work hours Ten (10) hours per day

..... Five (5) days per week

ABBREVIATED WRITTEN SUMMARY:

Briefly and without force and effect upon the Contract Documents, the Work of the Contract can be summarized as including removal and disposal of asbestos-containing materials associated with:

FLJY

License No. 10-5279
10/18/18

- Σ Non-Asbestos Containing Material Demolition
- Σ Pipe Insulation
- Σ Contaminated Soil

in the following approximate quantities*:

* Quantities listed are estimates only. The **CONTRACTOR** is responsible for verifying quantity estimates prior to submission of bid. The **CONTRACTOR** shall perform work for materials and locations indicated, regardless of actual quantities, and no increase in Contract amount will be allowed for quantity adjustment.

BASE BID:

PIPE INSULATION

Behind Ceramic Tile Walls

Boys Locker Room / Showers -200 Ln. Ft.

Girls Locker Room / Showers..... -200 Ln. Ft.

PIPE INSULATION IN CRAWL SPACE

Kitchen

In Crawl Space Directly Under Kitchen -200 Ln. Ft.

ASBESTOS CONTAMINATED SOIL

Kitchen

In Crawl Space Directly Under Kitchen -1,200 Sq. Ft.

Boys & Girls Locker Room / Showers

In Crawl Space Directly Under Boys & Girls Locker Room / Showers-1,500 Sq. Ft.

GENERAL NOTES:

Remove loose insulation and up to 3” of contaminated soil.

FLFYA

License No. 10-5279
10/18/18

SECTION 028200.01000
SUMMARY OF WORK
PAGE 3

SUMMARY BY SPECIFICATION SECTION:

The Work includes removal of asbestos-containing materials (ACM) according to the requirements of the following specification sections:

PROJECT INFORMATION:

- Section 00010 – Directory
- Section 00900 – Project Drawings
- Section 01000 – Summary of the Work

ADMINISTRATIVE PROCEDURES:

- Section 01050 – Project Coordination
- Section 01100 – Definitions and Standards
- Section 01200 – Codes and Regulations
- Section 01350 – Shop Drawings, Product Data and Samples
- Section 01360 – Substitutions and Product Options
- Section 01370 – Product Handling
- Section 01380 – Temporary Facilities
- Section 01390 – Project Closeout

AIR MONITORING / INSPECTION / LABORATORY TESTING SERVICES:

- Section 01400 – Air Monitoring and Inspection:
 - Testing Laboratory Services
 - Describes air monitoring procedures that will be followed by the **CONSULTANT** for the purpose of maintaining building spaces beyond the Work Area in an uncontaminated condition.
 - Personal air monitoring to determine and maintain required respiratory protection is the responsibility of the **CONTRACTOR**.
- Section 01410 – Final Clearance (Aggressive PCM)
 - Describes the analytical methods used to determine if the work area has been successfully cleaned of contamination.

Section 01420 – Final Clearance (Aggressive TEM)

Describes the analytical methods used to determine if the work area has been successfully cleaned of contamination.

Section 01430 – Final Clearance (Static PCM)

Describes the analytical methods used to determine if the work area has been successfully cleaned of contamination.

REMOVAL PROCEDURES:

Section 01500 – Temporary Containment

Details the requirements for the sheet plastic barriers isolating the work area from the balance of the building.

Section 01510 – Pre-cleaning and Decontamination Procedures

Sets forth procedures to be used on contaminated objects and rooms prior to containment, and contaminated objects and rooms which are not part of an abatement containment area.

Section 01520 – Decontamination Units

Details the requirements for the setup and operation of the personnel and material decontamination units.

Section 01530 – Ventilation System

Sets forth the procedures to set up the ventilation machines and ventilation of the work area.

Section 01540 – Removal of Asbestos-Containing Materials

Section 01548 – Removal of Mechanical Equipment Insulation

Section 01549 – Removal of Pipe Insulation

Section 01550 – Removal of Pipe Insulations (Glove-Bag Method)

Section 01555 – Removal of Pipe Insulation in Crawl Space

Section 01560 – Removal of Asbestos-Contaminated Soil

Section 01580 – Removal of Temporary Containment

Describes the sequence of cleaning and decontamination procedures to be followed during removal of the sheet plastic barriers isolating a Work Area.

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Section 01590 – Disposal of Asbestos-Containing Waste Material

PERSONNEL PROTECTION (ASBESTOS ABATEMENT):

Section 01700 – Worker Protection: Asbestos Abatement

Describes the equipment and procedures for protecting workers against asbestos contamination and other workplace hazards, except for respiratory protection.

Section 01710 – Respiratory Protection

Sets forth the procedures and equipment required for adequate protection against inhalation of airborne asbestos fibers.

GENERAL CONSTRUCTION:

Section 02000 – Demolition Work (Non-ACM)

Section 02050 – Non-ACM Building Demolition

Section 15200 – Repair of Insulation and Lagging

PLAN OF ACTION:

Submit a detailed plan of the procedures proposed for use in complying with the requirements of this specification. Include in the plan the location and layout of decontamination areas and ventilation system, the sequencing of asbestos work, the name and description of mechanical equipment utilized for removal operations inside containments, the interface of trades involved in the performance of abatement work and other construction work that may be occurring on the site, methods to be used to assure the safety of building occupants and visitors to the site, fire action plan, disposal plan for removing ACM from the site. The plan must be approved by the CONSULTANT prior to commencement of work. In the event of time restraints, the CONSULTANT may approve verbal discussion of the plan of action. In such event, the CONTRACTOR shall submit written summary of the discussion as documentation.

Submit a written, updated Plan of Action, including Work Schedule, with each payment request. Update shall reflect changes made prior to the payment request and changes required to successfully complete the next phase of Work.



License No. 10-5279
10/18/18

SECTION 028200.01000
SUMMARY OF WORK
PAGE 6

SEPARATE CONTRACTS:

Separate contracts are being issued for bid to perform other work at the site which will follow the work of this Contract. Separate contract work can be summarized as follows:

General Remodel Construction Work

Part 2 – PRODUCTS (Not Applicable)

Part 3 – EXECUTION (Not Applicable)



License No. 10-5279
10/18/18

PAGE 1

PROJECT COORDINATION

SECTION 028200 01050

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUMMARY:

Minimum administrative and supervisory requirements necessary for coordination of work on the project include but are not necessarily limited to the following:

- Administrative and supervisory personnel
- Special reports
- Notifications to other entities at job site

EMERGENCY PHONE LIST:

CONTRACTOR shall submit an Emergency Phone List to **CONSULTANT** as part of the Pre-Construction Submittals. **CONTRACTOR** shall post Emergency Phone List.

ADMINISTRATIVE AND SUPERVISORY PERSONNEL:

Provide a full-time on-site General Superintendent who is familiar with and experienced in administration and supervision of asbestos abatement projects including work practices, regulations, protective measures for building and personnel, disposal procedures, and other applicable related asbestos abatement concerns.

This person is the Competent Person as required by OSHA in 29 CFR 1926 for the **CONTRACTOR** and is the **CONTRACTOR**'s representative responsible for compliance with applicable federal, state and local regulations, and in particular, those relating to asbestos-containing materials.

The General Superintendent must have completed and maintain current training requirements in supervision of asbestos abatement projects, have had a minimum of one (1) year on-the-job training and meet additional requirements set forth in 40 CFR Part 763 and 29 CFR 1926 for a Competent Person.

The General Superintendent shall be licensed in accordance with state law.

FLF

License No. 10-5279
10/18/18

SECTION 028200.01050
PROJECT COORDINATION
PAGE 2

The General Superintendent shall be acceptable to the **OWNER** and shall remain acceptable throughout the Project. The **CONTRACTOR** shall immediately replace a General Superintendent who becomes unacceptable to the **OWNER**, and the Work shall not proceed until an acceptable General Superintendent is on-site.

SPECIAL REPORTS:

General: Except as otherwise indicated, submit special reports directly to **OWNER** within one day of occurrence requiring special report, with copy to **CONSULTANT** and others affected by occurrence.

Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure of ventilation system, rupture of temporary enclosures), prepare and submit a special report, or daily log sheet, listing chain of events, persons participating, response by **CONTRACTOR**'s personnel, evaluation of results or effects, and similar pertinent information. When such events are known or predictable in advance, advise **OWNER** and **CONSULTANT** in advance at earliest possible date.

Reporting Accidents: Report accidents immediately to the **CONSULTANT**. Prepare and submit reports, or daily log sheet, to the **OWNER** and **CONSULTANT** of significant accidents where work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279

10/18/18

PAGE 1

DEFINITIONS AND STANDARDS

SECTION 028200 01100

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

GENERAL DEFINITIONS:

General Explanation: A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including Drawings. Certain terms used in Contract Documents are defined in this article. Definitions and explanations of this section are neither necessarily complete nor exclusive, but are general for the work to the extent they are not stated more explicitly in another element of Contract Documents. The **CONTRACTOR** is responsible for clarifying definitions and terms with the **CONSULTANT**. The **CONSULTANT**'s interpretation of the definitions will be final and binding.

General Requirements: The general provisions or requirements apply to the entire work of Contract and, where so indicated, to other elements which are included in project.

Indicated: The term "Indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in Contract Documents.

Directed, Requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by **CONSULTANT**," "requested by **CONSULTANT**," and similar phrases. However, no such implied meaning will be interpreted to extend **CONSULTANT**'s responsibility into **CONTRACTOR**'s responsibility for construction supervision.

Approve: Where used in conjunction with **CONSULTANT**'s response to submittals, requests, applications, inquiries, reports and claims by **CONTRACTOR**, the meaning of term "approved" will be held to limitations of **CONSULTANT**'s responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by **CONSULTANT** be interpreted as a release of **CONTRACTOR** from responsibilities to fulfill requirements of Contract Documents.

Project Site: The term "project site" is defined as the space available to **CONTRACTOR** for performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of project site may be shown on the drawings, and may or may not be identical with the actual area in which the project occurs.



License No. 10-5279
10/18/18

Furnish: The term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

Install: The term "install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing protecting, cleaning and similar operations, as applicable in each instance.

Provide: The term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

Testing Laboratory: is defined as an independent entity engaged to perform specific inspections or tests of the work, either at project site or elsewhere; and to report and (if required) interpret results of those inspections or tests. For this project the Testing Laboratory is the **CONSULTANT**.

CONSULTANT: The **CONSULTANT** will represent the **OWNER** during construction and until final payment is due. The **CONSULTANT** will advise and consult with the **OWNER**. The **OWNER's** instructions to the **CONTRACTOR** will be forwarded through the **CONSULTANT**; the **CONTRACTOR's** correspondence with the **OWNER** shall be forwarded through the **CONSULTANT**. The **CONSULTANT** is a full-time representative of the **OWNER** at the project site.

General Superintendent: the **CONTRACTOR's** representative at the project site.

DEFINITIONS RELATIVE TO ASBESTOS ABATEMENT:

Abatement: Activities designed to control asbestos hazards, including preparatory work, removal operations, encapsulation, enclosure, and associated activities.

Aerosol: A system consisting of particles, solid or liquid, suspended in air.

Air Monitoring: The process of measuring the fiber content of a specific volume of air.

Amended Water: Water to which a surfactant has been added.

Asbestos: The asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite (amosite), anthophyllite, and actinolite-tremolite. For purposes of determining respiratory and worker protection both the asbestiform and non-asbestiform varieties of the above minerals and any of these materials that have been chemically treated and/or altered shall be considered as asbestos.

Asbestos-Containing Material (ACM): Material containing more than 1% by weight of asbestos of any type or mixture of types.



License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 3

Asbestos-Containing Waste Material: Material which is contaminated with an asbestos-containing material.

Authorized Visitor: The **OWNER**, the **CONSULTANT**, testing lab personnel, or a representative of any federal, state and local regulatory or other agency having authority over the project. Any other visitor to the site who has been authorized by the **OWNER** prior to site access.

Barrier: A surface that seals the work area to inhibit the movement of fibers.

Breathing Zone: A hemisphere forward of and even with the shoulders having a radius of approximately six (6) to nine (9) inches.

Ceiling Concentration: The concentration of an airborne substance that shall not be exceeded.

Certified Industrial Hygienist (C.I.H.): An industrial hygienist certified by the American Board of Industrial Hygiene.

Containment: (see Enclosure)

Critical Barriers: Barriers installed to seal openings to the work area such as vents, grilles, diffusers, electrical openings, etc.

Demolition: The wrecking or taking out of any building component, system, finish or assembly of a facility together with any related handling operations.

Disposal Bag: Minimum 6 mil thick, manufactured, leak-tight plastic bags used for transporting asbestos waste from work areas to disposal site.

Encapsulant: A material that surrounds or embeds asbestos fibers in an adhesive matrix, to prevent release of fibers.

Bridging encapsulant: an encapsulant that forms a discrete layer on the surface of an in situ asbestos matrix.

Penetrating encapsulant: an encapsulant that is absorbed by the in situ asbestos matrix without leaving a discrete surface layer.

Removal encapsulant: a penetrating encapsulant specifically designed for removal of asbestos-containing materials rather than for in situ encapsulation.

Encapsulation: The coating of asbestos-containing materials with a bonding or sealing agent to prevent the release of airborne fibers.

FLJ

License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 4

Enclosure (Containment): The construction of an air-tight, impermeable barrier around asbestos-containing material to control the release of asbestos fibers into the air.

Filter: A media component used in respirators to remove solid or liquid particles from the inspired air.

Friable Asbestos-containing Material: Material that contains more than 1.0% asbestos by weight, and that can be crumbled, pulverized, or reduced to powder by hand pressure when dry.

Glove-bag: A sack (typically constructed of 6 mil transparent polyethylene or polyvinylchloride plastic) with two inward projecting long-sleeve gloves, which are designed to enclose an object from which an asbestos-containing material is to be removed.

HEPA Filter: A High Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.

HEPA Filter Vacuum Collection Equipment (HEPA vacuum): High efficiency particulate air (absolute) filtered vacuum collection equipment with a filter system capable of collecting and retaining asbestos fibers. Filter type shall be 99.97% efficient for retaining fibers of 0.3 microns or larger.

High-Efficiency Filter: A filter which removes from air 99.97% or more of monodisperse dioctyl phthalate (DOP) particles having a mean particle diameter of 0.3 microns.

Negative Pressure Respirator: A respirator in which the air pressure inside the respiratory-inlet covering is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

Personal Monitoring: Sampling of the asbestos fiber concentrations within the breathing zone of an employee.

Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.

Reduced Air Pressure: Air pressure lower than surrounding areas, generally caused by exhausting air from a sealed space (work area).

Removal (Remove): The removal of visible or detectable asbestos-containing material or waste from the removal surface and work area as inspected and approved by the **CONSULTANT** followed by encapsulation of the cleaned removal surface. Removal of a material includes complete removal of over spray on vents, light fixture receptacles, adjacent surfaces, etc. Removal also includes clean up of asbestos-containing debris in the designated work area.



License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 5

Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

Time Weighted Average (TWA): The average concentration of a contaminant in air during a specific time period.

Ventilation System: A local exhaust system, utilizing HEPA filtration capable of maintaining a reduced air pressure inside the work area and a constant air flow from adjacent areas into the work area and exhausting that air outside the work area.

Visible Emissions: Emissions containing particulate material that are visually detectable without the aid of instruments. This does not include condensed uncombined water vapor.

Visual Inspection (Final): The process of visual confirmation of completion of the removal and decontamination process prior to Final Clearance air testing. Visually clean means that visually detectable dust and debris has been removed from the work area as confirmed by visual inspection, wipe tests or other methods to detect optically visible particles as determined by the **CONSULTANT**.

Wet Cleaning (or Wet Wiping): The process of decontaminating building surfaces and objects by using cloths, mops, or other cleaning utensils, which have been dampened with amended water or diluted removal encapsulant.

Work Area: The area where asbestos related work or removal operations are performed which is defined and/or isolated to prevent the spread of asbestos dust, fibers or debris, and to prevent entry by unauthorized personnel. Work area is a Regulated Area as defined by 29 CFR 1926.1101(b).

FORMAL AND SPECIFICATION EXPLANATIONS:

Imperative language is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the **CONTRACTOR**. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities, which must be fulfilled indirectly by **CONTRACTOR**, or when so noted, by others.

Section numbering is used to facilitate cross-references in the Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at the beginning of the Project Manual must be consulted to determine numbers and names of specification sections in Contract Documents.



License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 6

Overlapping and Conflicting Requirements: Where compliance with two (2) or more industry standards or sets of requirements is specified, and overlapping of different standards or requirements establishes different or conflicting minimums or levels or quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer apparently-equal-but- different requirements, and uncertainties as to which level of quality is more stringent, to the **CONSULTANT** for interpretation before proceeding. Communications and instructions from the **CONSULTANT** to the **CONTRACTOR** must be in writing to be binding. Verbal communications must be confirmed in writing and acknowledged in writing by the **CONSULTANT** to be binding.

Abbreviations: The language of Contract Documents is of abbreviated type in certain instances, implying words and meanings, which will be appropriately interpreted. Actual work abbreviations of a self-explanatory nature have been included in the texts. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in the section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

INDUSTRY STANDARDS:

General Applicability of Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, applicable standards of the construction industry have the same force and effect (and are made a part of Contract Documents by reference) as if copied directly into Contract Documents, or as if published copies were bound herewith. Refer to the other Contract Documents for resolution of overlapping and conflicting requirements, which result from the application of several different industry standards to the same unit of work.

Refer to individual unit of work sections for indications of which specialized codes and standards the **CONTRACTOR** must keep at the project site, available for reference.

Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date of Contract Documents.

Abbreviations and Names: The following acronyms or abbreviations as referenced in Contract Documents are defined to mean the associated names. Both names and addresses are subject to change, and are believed to be, but are not assured to be, accurate and up-to-date as of date of Contract Documents:

FLJ

License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 7

- AIA American Institute of Architects
1735 New York Avenue, N. W.
Washington, D.C. 20006
202/626-7474
- ANSI American National Standards Institute
1430 Broadway, New York, NY 10018
212/354-3300
- ASHRAE American Society for Heating, Refrigerating, and
Air Conditioning Engineers
1791 Tullie Circle, N.E., Atlanta, GA 30329
404/636-8400
- ASTM American Society for Testing and Materials
1916 Race Street, Philadelphia, PA 19103
215/299-5400
- CFR Code of Federal Regulations
Available from Government Printing Office,
Washington, D.C. 20402 (usually first published in Federal Register)
- CGA Compressed Gas Association
1235 Jefferson Davis Highway
Arlington, VA 22202
703/979-0900
- CS Commercial Standard of NBS (U.S. Dept. of Commerce)
Government Printing Office
Washington, D.C. 20402
- EPA Environmental Protection Agency
401 M. Street, S.W., Washington, D.C. 20460
202/382-3949
- FS Federal Specification (General Services Admin.)
Obtain from your Regional GSA Office, or
purchase from GSA Specifications Unit (SFSIS),
Seventh and D Streets, S.W.
Washington, D.C. 20406
202/472-2205 or 2140

FLJ

License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 8

GA	Gypsum Association 1603 Orrington Avenue, Evanston, IL 60201 312/491-1744
GSA	General Services Administration F St. and 18th Street, N.W. Washington, D.C. 20405 202/655/4000
MIL	Military Standardization Documents (U.S. Dept. of Defense) Naval Publications and Forms Center 5801 Tabor Avenue, Philadelphia, PA 19120
NIST	National Institute of Standards and Technology (U.S. Dept. of Commerce) Gaithersburg, MD 20234 301/921-1000
NEC	National Electrical Code (by NFPA)
NFPA	National Fire Protection Association Batterymarch Park, Quincy, MA 02269 617/770-3000
OSHA	Occupational Safety & Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402
PS	Product Standard of NBS (U.S. Dept. of Commerce) Government Printing Office Washington, D.C. 20402
UL	Underwriters Laboratories 333 Pfingsten Rd., Northbrook, IL 60062 312/272/8800

TRADE UNION JURISDICTIONS:

The manner in which Contract Documents have been organized and subdivided is not intended to be an indication of jurisdictional or trade union agreements.

FLJY

License No. 10-5279
10/18/18

SECTION 028200.01100
DEFINITIONS AND STANDARDS
PAGE 9

Maintain complete current information on jurisdictional matters, regulations actions and pending actions, as applicable to the work. Assign the work, and employ tradesmen and laborers, in a manner, which will not unduly risk jurisdictional disputes of a kind that could result in conflicts, delays, claims and losses in the performance of the work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279
10/18/18

PAGE 1

CODES AND REGULATIONS

SECTION 028200 01200

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUMMARY:

This section sets forth governmental regulations and industry standards, which are included and incorporated herein by reference and made a part of the specification. This section also sets forth those notices, permits and licenses which are known to the **OWNER** and which either must be applied for or received, or which must be given to governmental agencies before start of work.

CODES AND REGULATIONS:

General Applicability of Codes, Regulations, and Standards: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, applicable codes, regulations, and standards have the same force and effect (and are made a part of the Contract Documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.

CONTRACTOR Responsibility: The **CONTRACTOR** shall be responsible for compliance with applicable Federal, State, and Local regulations pertaining to the Work, including work practices, transportation and disposal of asbestos waste materials, protection of workers, visitors to the site, and persons occupying areas adjacent to the site.

The **CONTRACTOR** shall be responsible for providing medical examinations and maintaining medical records of personnel as required by applicable Federal, State, and Local regulations.

The **CONTRACTOR** shall hold the **OWNER** and **CONSULTANT** harmless for failure to comply with applicable regulations, including those pertaining to work practices, transportation and disposal of asbestos waste materials, protection of workers, visitors to the site, and persons occupying areas adjacent to the site; on the part of himself, his employees, and his authorized personnel, and will bear all costs associated therewith.

Federal Requirements: The **CONTRACTOR** shall abide by Federal requirements, which govern asbestos abatement work, transportation and disposal of asbestos waste materials, including, but not limited to, the following:



License No. 10-5279
10/18/18

SECTION 028200.01200
CODES AND REGULATIONS
PAGE 2

U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:

Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules, 29 CFR 1910.1001 and 29 CFR 1926.1101. Respiratory Protection, 29 CFR 1910.134.

Access to Employee Exposure and Medical Records, 29 CFR 1910.20.

Hazard Communication 29 CFR 1926.59.

Specifications for Accident Prevention Signs and Tags, 29 CFR 1910.145.

U.S. Environmental Protection Agency (EPA) including but not limited to:

Regulation for Asbestos, 40 CFR Part 61, Sub-part A.

National Emission Standard for Asbestos, 40 CFR 61, Sub-part M.

National Emission Standards for Hazardous Air Pollutants; Asbestos NESHAP Revision; Final Rule, 40 CFR, Part 61, dated November 20, 1990.

Asbestos Abatement Projects; Worker Protection; Final Rule, 40 CFR 763

State Requirements: The **CONTRACTOR** shall abide by State requirements, which govern asbestos abatement work, transportation and disposal of asbestos waste materials, including, but not limited to, the following:

Texas Department of State Health Services, Title 25 Health Services, Part I, 25 TAC 289.31 - 295.73, Texas Asbestos Health Protection Rules.

Local Requirements: The **CONTRACTOR** shall abide by Local requirements, which govern asbestos abatement work including, but not limited to, transportation and disposal of asbestos waste materials.

STANDARDS:

Standards, which govern asbestos abatement work, transportation and disposal of asbestos waste materials, include, but are not limited to, the following:

American National Standards Institute (ANSI)
1430 Broadway, New York, New York, 10018, (212) 354-3300.



License No. 10-5279
10/18/18

SECTION 028200.01200
CODES AND REGULATIONS
PAGE 3

Fundamentals Governing the Design and Operation of Local Exhaust Systems Publication Z9.2-79, revised 1991.

Practices for Respiratory Protection Publication Z288.2-80.

American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA, 19103, (215) 299-5400.

Safety and Health Requirements Relating to Occupational Exposure to Asbestos E 849-82.

NOTICES:

U.S. Environmental Protection Agency (EPA): The **CONTRACTOR** shall send Written Notification as required by USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR Part 61) to the appropriate regional office of the Texas Department of State Health Services, operating as EPA Administrator in the State of Texas.

State of Texas, Texas Department of State Health Services (TDSHS): The **CONTRACTOR** shall send Written Notification as required by the State of Texas, Texas Civil Statutes, Article 4477-3a, Paragraph 295.61.

Fees: Obtain as required by regulatory agencies. The **CONTRACTOR** shall pay for permits, fees, and similar costs as may be required for the execution of the Work. Invoices or notifications of such costs as may be directed to the **OWNER** will be forwarded to the **CONTRACTOR** for resolution and payment.

LICENSES:

Licenses: Maintain current licenses as required by applicable jurisdictions for the removal, transportation, disposal or other regulated activity relative to the Work.

SUBMITTALS:

Before start of Work submit the following to the **CONSULTANT** for review. Each of the following documents shall be current and remain current during the course of the project. If a document expires during the course of the project, Work will not be allowed to proceed until an updated document has been submitted to the **CONSULTANT**.

Notices: Submit notices required by federal, state and local regulations together with proof of timely transmittal to agency requiring the notice.

Permits: Submit copies of required, current, valid permits.

FLFYA

License No. 10-5279
10/18/18

SECTION 028200.01200
CODES AND REGULATIONS
PAGE 4

Licenses: Submit copies of required, current, valid licenses including, but not limited to, Contractor and Supervisor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279
10/18/18

PAGE 1

SHOP DRAWINGS, PRODUCT DATA, SAMPLES

SECTION 028200 01350

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DRAWINGS:

Present in clear and thorough manner.

Identify details by reference to sheet and detail numbers or room number shown on Drawings.
Maximum Sheet Size: 30" x 42".

PRODUCT DATA:

Clearly mark each copy to identify pertinent products or models.

Show performance characteristics and capacities.

Show dimensions and clearances required.

Show wiring or piping diagrams and controls.

Manufacturer's standard schematic drawings and diagrams:

- Σ Modify drawings and diagrams to delete information not applicable to Work.
- Σ Supplement standard information to provide information specifically applicable to Work.

SAMPLES:

Provide sufficient size and quantity to clearly illustrate:

- Σ Functional characteristics of product, with integrally related parts and attachment devices.
- Σ Full range of color, texture and pattern.



License No. 10-5279
10/18/18

SECTION 028200.01350
SHOP DRAWINGS, PRODUCT DATA, SAMPLES
PAGE 2

SUBMISSION REQUIREMENTS:

Submit shop drawings, product data and samples sufficiently in advance of time returned copies are required to allow review by **CONSULTANT** and re-submittal, if required.

Submit the OSHA Material Safety Data Sheet (MSDS) for solvents, encapsulants and other chemicals to be used on the Project site.

Submittals shall contain:

- Σ Date of submission (including previous submissions).
- Σ Project title and number.
- Σ Names of **CONTRACTOR**, supplier and manufacturer.
- Σ Identification of product, with specification section number where applicable.
- Σ Field dimensions, clearly identified as such.
- Σ Relation to adjacent or critical features of work or materials.
- Σ Applicable reference standards.
- Σ Identification of deviations from requirements of Contract Documents.
- Σ Identification of revisions on resubmittal.

RESUBMISSION:

Revise submittals as required and resubmit as specified for initial submittal. Indicate any changes, which have been made other than those, requested by **CONSULTANT**.

CONTRACTOR RESPONSIBILITIES:

Schedule submittals according to general flow of Work and so as to allow for adequate and timely review of submittals by **CONSULTANT**.

Review submittals prior to submission and submit to **CONSULTANT** in accordance with provisions herein.

Verify field measurements, construction criteria, catalog numbers and similar data.



License No. 10-5279
10/18/18

SECTION 028200.01350
SHOP DRAWINGS, PRODUCT DATA, SAMPLES
PAGE 3

Coordinate submittals with requirements of Work and Contract Documents.

CONTRACTOR's responsibility for errors or omissions is not relieved by **CONSULTANT's** review.

CONTRACTOR's responsibility for deviations from requirements of Contract Documents is not relieved by **CONSULTANT's** review, unless **CONSULTANT** is notified of deviations in writing at time of submittal and gives written review of specific deviations.

Do not begin work, which requires submittals until reviewed submittals have been received from **CONSULTANT**.

Reproduce and distribute copies after **CONSULTANT's** review.

CONSULTANT'S RESPONSIBILITIES:

Review submittals within ten (10) days or indicate in writing reasons for reviews, which require additional time.

Review for conformance with design concept of project and information given in Contract Documents.

Indicate results of review and return submittals to **CONTRACTOR** for distribution.

CONSULTANT is not responsible for verification of field measurements, construction criteria, catalog numbers and other similar data.

Review of separate item does not constitute review of an assembly in which item functions.

DISTRIBUTION: Distribute reviewed copies to **CONTRACTOR's** file, Project site file, and other parties as required.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279

10/18/18

PAGE 1

SUBSTITUTIONS AND PRODUCT OPTIONS

SECTION 028200 01360

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

CONTRACTOR'S OPTIONS:

For products specified only by reference standards, select any product meeting standard.

For products specified by naming several products or manufacturers, select any named.

For products specified by naming products, provide product specifically named.

SUBSTITUTIONS:

CONSULTANT will consider formal requests for substitution of products in place of those specified, if requests are submitted a minimum of two (2) weeks prior to use or installation of the product.

In making request for substitution, **CONTRACTOR** represents that:

- Σ He has investigated proposed substitution and determined that it is equal or superior to that specified for the intended use.
- Σ He will provide same warranty as for product or method specified.
- Σ He will coordinate installation of accepted substitution into Work, making changes as may be required to complete Work.
- Σ He waives claims for additional costs related to substitution, which may subsequently become apparent.
- Σ Cost data is complete and includes related costs under Contract, excluding **CONSULTANT's** redesign.

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License No. 10-5279
10/18/18

SECTION 028200.01360
SUBSTITUTIONS AND PRODUCT OPTIONS
PAGE 2

Substitutions will not be considered if:

- Σ They are indicated or implied on shop drawings or data submittals without formal request.
- Σ Acceptance will require substantial revision of Contract Documents.

CONTRACTOR alone shall be responsible for substantiating acceptability of proposed substitutions.

CONSULTANT's decision in acceptance or non-acceptance of substitutions will be final.

SUBMITTALS:

Submit three copies, plus copies as needed for return, of each request for substitution, including complete data substantiating compliance of proposed substitution with Contract Documents.

For products:

- Σ Product identification, including name and address of manufacturer.
- Σ Product description, performance and test data, and reference standards.

For construction methods:

- Σ Detailed description of proposed method.
- Σ Illustrative drawings.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279
10/18/18

PAGE 1

PRODUCT HANDLING

SECTION 028200 01370

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provision of contract, including general and supplementary conditions, apply to the work of this section.

QUALITY ASSURANCE:

Include within the **CONTRACTOR**'s quality assurance program such procedures as are required to assure full protection of Work and materials.

MANUFACTURERS' RECOMMENDATIONS:

Except as otherwise approved by the **CONSULTANT**, determine and comply with manufacturers' recommendations on product handling, storage, and protection.

PACKAGING:

Deliver products to the Project site in manufacturer's original container, with labels intact and legible.

Maintain packaged materials with seals unbroken and labels intact until time of use.

Promptly remove damaged material and unsuitable items from the Project site, and promptly replace with material meeting the specified requirements, at no additional cost to the **OWNER**.

The **CONSULTANT** may reject as non-complying such material and products that do not bear identification satisfactory to the **CONSULTANT** as to manufacturer, grade, quality, and other pertinent information.

PROTECTION:

Protect finished surfaces, including jambs, heads and soffits of openings used as passageways, through which equipment and materials are handled.



License No. 10-5279
10/18/18

SECTION 028200.01370
PRODUCT HANDLING
PAGE 2

Provide protection for finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.

Maintain finished surfaces clean, unmarred, and suitably protected throughout Project Duration.

REPAIRS AND REPLACEMENTS:

In event of damage, promptly make replacements and repairs to the satisfaction of the **CONSULTANT** and at no additional cost to the **OWNER**.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279
10/18/18

PAGE 1

TEMPORARY FACILITIES

SECTION 028200 01380

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF REQUIREMENTS:

Provide temporary connection to existing building utilities or provide temporary facilities as required herein or as necessary to carry out the work.

STANDARDS:

Scaffolding: Comply with OSHA and other applicable regulations regarding the type, erection and use of scaffolding.

Electrical Service: Comply with applicable NEMA, NECA and UL standards and governing regulations for materials and installation of temporary electric service and hot water heater.

Heating Units: Temporary heating units shall have been tested and labeled by UL, FM or another recognized trade association related to the fuel being consumed.

Fire Extinguishers: Comply with the applicable recommendations of NFPA Standard 10 "Standard for Portable Fire Extinguishers".

PART 2 - PRODUCTS

GENERAL:

Provide new or used materials and equipment that are undamaged and in serviceable condition. Provide only materials and equipment that are recognized as being suitable for the intended use, by compliance with appropriate standards.

SCAFFOLDING:

Provide scaffolding, ladders and/or staging, etc. as necessary to accomplish the work of this contract. Scaffolding may be of suspension type; or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type.

Equip rungs of metal ladders, etc. with an abrasive non-slip surface. Provide a nonskid surface on scaffold surfaces subject to foot traffic.

WATER SERVICE:

Temporary Water Service Connection: Connections to the **OWNER's** water system shall include backflow protection.

Water connection to **OWNER's** existing potable water system is limited to one 3/4" pipe-size connection, and a maximum flow of 10 gpm each to hot and cold water supply. Hot water shall be supplied at a minimum temperature of 100°F.

Valves shall be temperature and pressure rated for operation of the temperatures and pressures encountered.

Water Hoses: Employ heavy-duty abrasion-resistant hoses with a pressure rating greater than the maximum pressure of the water distribution system to provide water into each work area and to each Decontamination Unit. Provide fittings as required to allow for connection to existing wall hydrants or spouts, as well as temporary water heating equipment, branch piping, showers, shut-off nozzles and equipment.

Hot-Water Heater: Provide UL rated electric hot-water heater to supply hot water for the Decontamination Unit shower. Activate from appropriate amp circuit breaker located within the Decontamination Unit sub panel. Provide with relief valve compatible with water heater operation; pipe relief valve down to drip pan on floor with type L copper.

ELECTRICAL SERVICE:

General: Provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work throughout the Project duration.

Temporary Power: Provide service to sub panel with appropriate amp, two (2) pole circuit breaker or fused disconnect sized and equipped to accommodate electrical equipment required for completion of the work.

Provide overload-protected disconnect switch for each temporary circuit located at the power distribution center.

Voltage Differences: Provide identification-warning signs at power outlets, which are other than 110-120 volt power. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110-120 volt plugs into higher voltage outlets. Dry type transformers shall be provided where required to provide voltages necessary for work operations.

Ground Fault Protection: Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for plug-in connection or power tools and equipment.

FL J.Y.S.

License No. 10-5279
10/18/18

SECTION 028200.01380
TEMPORARY FACILITIES
PAGE 3

Electrical Wiring and Power Cords: Provide in the work area type UF (Underground Feeder) sheathed cable. Use only grounded extension cords in serviceable condition (no frayed or worn cords); use "hard-service" cords where exposed to abrasion and traffic. Use single lengths or use waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas of work. Provide liquid tight enclosures or boxes for wiring devices.

Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Protect lamps with guard cages or tempered glass enclosures, where fixtures are exposed to breakage by work activities. Provide exterior fixtures where fixtures are exposed to the weather or moisture.

Supplies for CONSULTANT: The **CONTRACTOR** shall provide a source of electrical power, adequate lighting, and electrical extension cords for **CONSULTANT**'s use throughout project duration.

TEMPORARY HEAT:

Use steam or hot water radiant heating units where available, and where not available use electric resistant fin radiation supplied from a branch circuit with ground fault circuit interrupter. Under no circumstances shall forced air or fan type units be utilized inside a Work Area.

SELF CONTAINED TOILETS:

Provide single-occupant self-contained toilet units of the chemical type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar non-absorbent material. Provide one self-contained chemical toilet unit in the work area for each 30 workers. These self-contained toilets shall be made available if no other agreements are made with the **OWNER**.

ACM WASTE STORAGE:

Provide a separate, lockable, fully enclosed metal container, trailer or vehicle for temporary **ACM** waste storage on site.

FIRST AID:

Provide first aid supplies and trained personnel in accordance with governing regulations and recognized recommendations within the construction industry.

FIRE EXTINGUISHERS:

Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is

FL J.Y.S.

License No. 10-5279
10/18/18

SECTION 028200.01380
TEMPORARY FACILITIES
PAGE 4

minimal danger of electrical or grease-oil-flammable liquid fires. In other locations, including inside of the containment, provide type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

PART 3 - EXECUTION

INSTALLATION:

Use qualified tradesmen for installation of temporary services and facilities. Locate temporary services and facilities where they will serve the entire project adequately and result in minimum interference with the performance of the Work.

Relocate, modify and extend services and facilities as required during the course of work so as to accommodate the entire work of the project.

SCAFFOLDING:

During the erection and/or moving of scaffolding, care must be exercised so that the polyethylene floor covering is not damaged. If damage occurs, it must be repaired immediately by appropriate means.

Clean as necessary, debris from non-slip surfaces.

At the completion of abatement work, clean construction aids within the work area, wrapping one (1) layer of 6 mil polyethylene sheet and seal before removal from the work area.

WATER SERVICE:

Supply hot and cold water to the Decontamination Unit.

Maintain hose connections and outlet valves in leak proof condition.

Where finish work below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize the possibility of water damage. Drain water promptly from pan as it accumulates.

After completion of use, connections and fittings shall be removed without damage or alteration to existing water piping and equipment. Leaking or dripping valves shall be piped to the nearest drain or located over an existing sink or grade where water will not damage existing finishes or equipment.

ELECTRICAL SERVICE:

Circuits shall be of adequate size and proper characteristics for each use. In general, run wiring overhead and rise vertically where wiring will be least exposed to water and to damage from work activities. Locate wiring overhead and exposed. Do not wire devices with exposed, insulated electrical conductors.

TEMPORARY LIGHTING:

Install temporary lighting as necessary to provide sufficient illumination for safe work and traffic conditions in every area of work, if no other agreements exist between the **CONTRACTOR** and **OWNER**.

TEMPORARY HEAT:

Provide temporary heat as necessary for performance of the Work and as indicated.

Maintain a minimum temperature of 70°F where finished work has been installed.

Maintain a minimum temperature of 75°F in the shower of the Decontamination Unit.

Maintain a minimum temperature of 70°F in the work area during work activities. At other times and at completion of removal work, but before start of reconstruction work, maintain a minimum temperature of 50°F.

SANITARY FACILITIES:

Provide temporary self-contained toilet facilities as necessary for **CONTRACTOR**'s own use. Facilities shall be clean and shall remain maintained in a condition acceptable to the **OWNER**. At Project completion, decontaminate and remove temporary toilets and restore the area to the condition prevalent at the time of initial use.

ACM WASTE STORAGE:

Locate temporary **ACM** waste storage unit as directed on site. Label properly in accordance with regulatory requirements. Maintain locked at all times, except during loading operations. Repair damage to landscape and site construction resulting from storage unit operations to the satisfaction of the **OWNER**.

FIRE EXTINGUISHERS:

Locate fire extinguishers as most convenient and effective for the intended purpose, not less than one (1) extinguisher per 1,000 square feet of Work Area with a maximum of fifty (50) feet travel distance from any location. Provide one (1) in Equipment Room and one (1) outside Work Area in Clean Room.



License No. 10-5279
10/18/18

PAGE 1

PROJECT CLOSEOUT

SECTION 028200 01390

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF REQUIREMENTS:

Project Closeout is the term used to describe certain collective Project requirements, indicating completion of the Work, that are to be fulfilled near the end of the Contract Time in preparation for final acceptance and occupancy of the Work by the **OWNER**, as well as final payment to the **CONTRACTOR** and the normal termination of the Contract.

Specific requirements for individual units of Work are included in appropriate Sections.

Time of Project Closeout is directly related to Substantial Completion; therefore, the time of closeout may be either a single time period for the entire Work or a series of time periods for individual elements of the Work that have been certified as substantially complete at different dates. This time variation, if any, shall be applicable to the other provisions of this Section.

PREREQUISITES TO SUBSTANTIAL COMPLETION:

General: Complete the following before requesting the **CONSULTANT** to inspect for substantial completion, either for the entire Work or for portions of the Work. Include list of known exceptions.

In the progress payment request that coincides with, or is the first request following, the date substantial completion is claimed, show either 100% completion for the portion of the Work claimed as "substantially complete" or list incomplete items, the value of incomplete Work, and reasons for the Work being incomplete.

Include supporting documentation for substantial completion.

Advise **OWNER** of pending insurance change-over requirements.

Obtain and submit releases enabling **OWNER**'s full, unrestricted use of the Work and access to services and utilities. Where required, include occupancy permits, operating certificates and similar releases.

Complete Final Cleaning requirements.



License No. 10-5279
10/18/18

SECTION 028200.01390
PROJECT CLOSEOUT
PAGE 2

Touch-up, repair, restore and/or replace marred finishes affected by the Work when such damaged or marred finishes are in excess of anticipated results of normal abatement operations. Degree of excessive damage and necessary repair procedures will be as determined by the **CONSULTANT**.

Inspection Procedures: Upon receipt of **CONTRACTOR**'s request for inspection, the **CONSULTANT** will either proceed with inspection or advise **CONTRACTOR** of unfulfilled prerequisites.

Results of the inspection will form the "punch-list" for final acceptance.

PREREQUISITES TO FINAL ACCEPTANCE:

General: Complete the following before requesting the **CONSULTANT**'s final inspection for final acceptance, and final payment as required by the General Conditions. List known exceptions, if any, in request.

Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required. **CONTRACTOR**'s Certificate of Completion is enclosed at the end of this section.

Submit evidence of final, continuing insurance coverage complying with insurance requirements.

Reinspection Procedure: The **CONSULTANT** will reinspect the Work upon receipt of the **CONTRACTOR**'s notice that the Work, including punch-list items resulting from earlier inspections, has been completed, except for these items whose completion has been delayed because of circumstances that are acceptable to the **CONSULTANT**. Upon completion of reinspection, the **CONSULTANT** will either prepare final acceptance documents, or will advise the **CONTRACTOR** of Work that is incomplete or of obligations that have not been fulfilled, but are required for final acceptance.

MODIFICATION OF PROCEDURES:

The **OWNER** and **CONSULTANT** may modify, waive, and/or combine procedures, submittals and requirements of the Project Documents as may be deemed in the **OWNER**'s best interest and as may be suitable to the size and scope of the Project.



License No. 10-5279
10/18/18

SECTION 028200.01390
PROJECT CLOSEOUT
PAGE 3

PART 3 - EXECUTION

FINAL CLEANING:

General: Special cleaning requirements for specific units of Work are included in the appropriate Sections.

Cleaning: Provide Final Cleaning of the Work as indicated. Employ licensed asbestos workers for final cleaning. Clean each surface or unit of Work to the condition expected from a normal, commercial building cleaning and maintenance program. Comply with the manufacturer's instructions for cleaning operations.

Complete the following cleaning operations before requesting the **CONSULTANT** to inspect for certification of Substantial Completion:

- Σ Remove exposed labels in finished spaces, which are not required as permanent labels on materials supplied as part of the Work, except for "Asbestos", "Asbestos Free", or Thermal Insulation Labels specified elsewhere.
- Σ Clean transparent materials affected by the Work, including mirrors and window/door glass, to a polished condition, removing substances, which are noticeably vision-obscuring materials.
- Σ Clean hard surfaced floors affected by the Work, using materials approved by the **OWNER**.
- Σ Clean exposed hard-surfaced finishes affected by the Work to a dirt-free condition, free of dust, stains, films and similar distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces.
- Σ Restore reflective surfaces to original reflective condition prior to Work.
- Σ HEPA vacuum carpeted surfaces and similar soft surfaces affected by the Work. Professionally clean to remove staining caused by the Work.
- Σ Clean toilet areas and plumbing fixtures affected by the Work to a sanitary condition, free of stains including stains from water exposure.
- Σ Replace disposable type HVAC Filters affected by the Work using materials supplied by the **OWNER**. Clean permanent type filters after minimum of eight (8) hours of operation of HVAC equipment after Final Clearance.
- Σ Clean light fixtures and lamps, which have been affected by the Work.



License No. 10-5279
10/18/18

SECTION 028200.01390
PROJECT CLOSEOUT
PAGE 4

- Σ Clean Project site (yard and grounds), including landscaped areas, of litter and foreign substances accumulated during the course of the Work.
- Σ Sweep paved areas, which have been affected by the Work to a broom-clean condition; remove stains, petrochemical spills and other foreign deposits left by the Work.
- Σ Rake unplanted grounds, which have been disturbed by the Work, to a smooth, even-textured surface.

Removal of Protection: Except as otherwise indicated or requested by the **CONSULTANT**, remove temporary protection devices and facilities, which were installed during the course of the Work to protect previously, completed work.

Comply with safety standards and governing regulations for cleaning operations.

Do not burn waste materials on the **OWNER's** property.

Do not bury debris or excess materials on the **OWNER's** property.

Do not discharge volatile or other harmful or dangerous materials into drainage systems. Remove waste materials from the Project site and dispose in accordance with regulatory requirements.

Where extra materials of value remaining after completion of associated Work have become the **OWNER's** property, store materials as directed by the **OWNER**.

Remove temporary facilities, equipment, materials, and debris from the Project site.

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License No. 10-5279
10/18/18

SECTION 028200.01390
PROJECT CLOSEOUT
PAGE 5

CONTRACTOR'S CERTIFICATE OF COMPLETION

TO: _____

OWNER/MANAGER: _____

PROJECT: _____

BUILDING NAME: _____

LOCATION WITHIN BUILDING: _____

The Work for the above referenced Project has been completed in accordance with applicable requirements of the United States Environmental Protection Agency, the Occupational Safety and Health Administration, the National Institute for Occupational Safety and Health, and state, county, and local agencies. The Work has also been performed in accordance with the Project Manual as prepared by the **CONSULTANT**.

SIGNED: (Authorized Representative) _____

TITLE: _____

DATE: _____



License No. 10-5279

10/18/18

PAGE 1

**AIR MONITORING AND INSPECTION
TESTING LABORATORY SERVICES**

SECTION 028200 01400

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF THE WORK:

This Section describes air monitoring and inspection services to be carried out by the **CONSULTANT** to verify that the Work performed is in compliance and that the building areas beyond the Work Area and the outside environment remain uncontaminated. This section also sets forth airborne fiber levels both inside and outside the Work Area as action levels, and describes the action required by the **CONTRACTOR** if an action level is met or exceeded.

AIR MONITORING:

The **CONSULTANT** will be conducting air monitoring throughout the course of the Project.

Base Line Fiber Levels: The **CONSULTANT** will monitor airborne fiber levels prior to start of Work. The purpose of this air monitoring will be to establish prevailing airborne fiber levels prior to beginning abatement operations.

Work Area Isolation: The **CONSULTANT** will monitor airborne fiber levels outside the Work Area.

The purpose of this air monitoring will be to monitor integrity of the Work Area isolation relating to, but not limited to, prevention of contamination of building areas outside of the Work Area, prevention of failure of filtration or rupture in the ventilation system, and prevention of contamination of the exterior of the building.

Should indications of failure of integrity of any of the above systems occur, the **CONTRACTOR** shall immediately cease asbestos abatement activities until the discrepancy is corrected. Work shall not recommence until authorized by the **CONSULTANT**.

Work Area Airborne Fiber Levels: The **CONSULTANT** will monitor airborne fiber levels inside the Work Area.

The purpose of this air monitoring will be to monitor airborne fiber levels to verify appropriateness of the Work Area isolation procedures including respiratory protection.

FLJY

License No. 10-5279
10/18/18

SECTION 028200.01400
AIR MONITORING AND INSPECTION
TESTING LABORATORY SERVICES
PAGE 2

Final Clearance: The **CONSULTANT** will conduct Final Clearance air sampling in accordance with the Final Clearance Section(s).

AIRBORNE FIBER LEVELS:

Inside Work Area: Maintain an average airborne fiber level in the Work Area of less than 0.1 fibers per cubic centimeter. If the fiber levels rise above this figure for any sample taken, revise work procedures to lower fiber levels. If the Time Weighted Average (TWA) fiber level for any Work shift or eight (8) hour period exceeds 0.2 fibers per cubic centimeter, stop Work and leave ventilation system in operation. Do not recommence Work until authorized in writing by the **CONSULTANT**.

Outside Work Area: Maintain an average airborne level outside the Work Area of less than or equal to Base Line as established below.

If any air sample taken outside the Work Area exceeds the Base Line, immediately and automatically stop Work until the **CONSULTANT** can determine the source of the excessive readings. If no outside non-asbestos source can be located by the **CONSULTANT** and if this air sample was taken inside the building and outside of Critical Barriers around the Work Area, immediately erect new Critical Barriers as set forth in Section 01500 to isolate the affected area from the balance of the building or as instructed by the **CONSULTANT**.

Erect Critical Barriers at the next existing structural isolation of the involved space (e.g. wall, ceiling, floor).

Decontaminate the affected area in accordance with Section 01510.

Respiratory protection as set forth in Section 01710 shall be worn in affected area until area is cleared for re-occupancy.

Leave Critical Barriers in place until completion of Work and insure that the operation of the reduced air pressure system in the Work Area results in a flow of air from the balance of the building into the affected area.

If the exit from the clean room of the personnel decontamination unit enters the affected area, establish a new decontamination facility.

After visual inspection by the **CONSULTANT** in the extended work area, remove Critical Barriers separating the Work Area from the affected area.

Include the affected area in the Work Area and proceed with the Work.

Fiber Type Disputes: The following procedure will be used to resolve disputes regarding fiber types when the Project has been stopped due to excessive airborne fiber levels:

FLJYS

License No. 10-5279
10/18/18

Air samples will be secured in the disputed area by the **CONSULTANT** for analysis by Transmission Electron Microscopy and classified as retests and back-charged to the **CONTRACTOR** in accordance with the procedures in this specification.

ANALYTICAL METHODS:

The **CONSULTANT** in collecting and analyzing air samples will utilize the following analytical methods:

Phase Contrast Microscopy (NIOSH 7400 Method A, Revision No. 3).

Transmission Electron Microscopy (NIOSH 7402, Yamate, or 40 CFR Part 763).

SAMPLE PROTOCOLS:

General: The number and volume of air samples taken by the **CONSULTANT** will generally be in accordance with the following schedule. Locations and methodologies may vary depending upon the analytical method and project layout used and at the discretion of the **CONSULTANT**.

SCHEDULE OF AIR SAMPLES:

Base Line Sample Schedule: The **CONSULTANT** will secure the following air samples to establish Base Line Fiber Levels prior to start of Work.

LOCATION SAMPLED	MINIMUM NUMBER OF SAMPLES	PLANNED ANALYTICAL METHOD
Each Work Area	1	PCM
Outside Each Work Area	1	PCM
Outside Building	1	PCM

Base Line Fiber Level: is an action level expressed in fibers per cubic centimeter, which is the larger of the following:

Average of the samples collected outside each work area.

FLJYS

License No. 10-5279
10/18/18

Minimum Base Line: 0.01 fibers per cubic centimeter.

Daily Sample Schedule (per 8-hour work period): From start of Work of Section 01500 through the Work of Section 01580, the **CONSULTANT** will take the following samples on a daily (8-hour work period) basis.

LOCATION SAMPLED PER 8 HR SHIFT	NUMBER OF SAMPLES	PLANNED ANALYTICAL METHOD
Each Work Area	2	PCM
Outside Each Work Area	3	PCM
Outside Building	1	PCM
Output Reduced Air Pressure System	1	PCM

If airborne fiber counts exceed baseline limits (except in Work Areas), additional samples will be taken (and classified as retests) as necessary to monitor fiber levels and confirm sources.

PRE-FINAL AIR SAMPLING (AGGRESSIVE PCM):

Aggressive PCM Pre-final Air Sampling will be performed by the **CONSULTANT** in the same manner as daily air sampling.

Release Criteria: Work prior to Pre-final Air Sampling is complete when every Work Area sample is below 0.01 fibers/cc or the Base Line outside the Work Area, whichever is greater. If any sample is above the limit indicated, then the Work is incomplete and re-cleaning by decontamination procedures and ventilation system cycling is required and containment barriers cannot be removed.

LABORATORY TESTING:

The **CONSULTANT** will perform laboratory analysis of the air samples. A microscope and technician will be set up at the Project site, at the option of the **CONSULTANT**, so that verbal reports on air samples can be obtained promptly after collection.



License No. 10-5279
10/18/18

Daily reports to the **OWNER** by the **CONSULTANT** will include air monitoring data and pertinent information on work being conducted such as: work hours, number of workers, procedures used, contractor discrepancies and corrective measures, containment methods and construction, and amount of **ACM** removed.

INSPECTIONS:

The **CONSULTANT**, in addition to providing air-monitoring services, will provide full-time, on-site inspection of Work activities. Work shall not proceed without prior notice (forty-eight (48) hour minimum) to the **CONSULTANT** and presence of the **CONSULTANT** on the Project site.

The **CONSULTANT**'s inspections do not relieve the **CONTRACTOR** of his Contract obligations and are not designed to locate all discrepancies.

Inspections will require forty-eight (48) hours advance notice to the **CONSULTANT**.

The **CONSULTANT** will conduct the following key Project inspections and no work by the **CONTRACTOR** shall proceed beyond each inspection until discrepancies noted during the inspection have been corrected.

Prep Inspection:

The **CONSULTANT** will inspect Work Area and Containment prior to start of removal activities (gross removal). Removal operations shall not proceed until the **CONSULTANT** has completed inspection of the Work Area preparations and until discrepancies noted have been corrected.

Inspections during gross removal:

Inspection of the Work Area and Work practices will be conducted on an ongoing basis. Upon report of discrepancies the **CONTRACTOR** shall immediately take corrective actions, including discontinuing removal activities if appropriate.

Gross Removal Completion Inspection:

The **CONSULTANT** will inspect the Work Area after completion of gross removal Work, including detail cleaning of substrate. Upon completion of the inspection by the **CONSULTANT** and correction of discrepancies noted, the **CONTRACTOR** shall proceed with removal of all but one layer of Containment Barriers and cleaning of the remaining layer in preparation of lockdown encapsulation.

Pre-encapsulation Inspection:

The **CONSULTANT** will inspect the Work Area after completion of Containment Barrier cleaning. Lock-down encapsulation shall not proceed until discrepancies noted have been corrected.



License No. 10-5279
10/18/18

Pre-final Inspection:

The **CONSULTANT** will inspect the Work Area after completion of encapsulation Work, but prior to removal of Containment Barriers. The **CONTRACTOR** shall correct discrepancies noted, and upon completion of corrections, the **CONSULTANT** will perform Pre-final Air Sampling.

Final Clearance Inspection:

The **CONSULTANT** will inspect the Work Area after completion of Pre-final Air Sampling, removal of Containment Barriers and clean-up, but prior to removal of Critical Barriers. The **CONTRACTOR** shall correct discrepancies noted, and upon completion of corrections, the **CONSULTANT** will perform Final Clearance Air Sampling.

Final Inspection:

The **CONSULTANT** will inspect the Project area after the **CONTRACTOR** has removed Critical Barriers, equipment, supplies, and performed final clean-up operations. Discrepancies, which are not or cannot be corrected expediently, will be assigned to a Project Punch List. Punch List items shall be resolved prior to Project Closeout.

Modifications: The above inspection schedule may be modified by the **CONSULTANT** to meet specific Project needs.

Failed inspections will be re-conducted and classified as retests.

PERSONAL MONITORING:

The **CONTRACTOR** shall perform air monitoring as required to meet OSHA Requirements for maintenance of Time Weighted Average (TWA) and excursion limit fiber counts for types of respiratory protection provided. The **OWNER** will not provide air-monitoring services to meet the **CONTRACTOR's** OSHA requirements.

The **CONTRACTOR** shall post results of OSHA required air monitoring within forty-eight (48) hours of sample collection.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279

10/18/18

PAGE 1

FINAL CLEARANCE (AGGRESSIVE PCM)

SECTION 028200 01410

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

AIR MONITORING:

To determine if airborne fiber levels following abatement operations have been reduced to acceptable standards, the **CONSULTANT** will secure and analyze air samples in accordance with the following procedures.

AGGRESSIVE SAMPLING:

Air Samples from Work Areas will be collected using aggressive sampling techniques at locations determined by the **CONSULTANT** as follows:

Before sampling pumps are started, the exhaust from forced air equipment (leaf blower with electric motor) will be swept against walls, ceilings, floors, ledges and other surfaces in the Work Area.

Fans will be mounted in central locations directed toward ceilings and operated at low speed continuously for the period of sample collection to maintain fiber suspension as determined by the **CONSULTANT**.

SCHEDULE OF AIR SAMPLES:

General: The number and volume of air samples taken and analytical methods used by the **CONSULTANT** will generally be in accordance with the following schedule. Sample quantities, volumes, and analytical methodologies may vary and will be at the discretion of the **CONSULTANT**.

In each homogeneous Work Area or as determined by the **CONSULTANT**, samples will be collected and analyzed as follows:

LOCATION SAMPLED	SCHEDULED NUMBER OF SAMPLES	FILTER MEDIA
Each Work Area	5	Cellulose Ester
Outside of Work Area	5	Cellulose Ester

Analysis: Fibers on each filter will be measured using the NIOSH 7400 procedures.

Release Criteria: Final Clearance (Aggressive PCM) of the Work Area is complete when every Work Area sample is below 0.01 fibers per cubic centimeter.

Re-cleaning: If the results of analysis of the Work Area samples fails to meet the release criteria, Final Clearance is incomplete, re-cleaning per Section 01580 is required, and re-testing is required until release criteria is met.

LABORATORY TESTING:

The **CONSULTANT** will be employed by the **OWNER** to perform laboratory analysis of the air samples.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279
10/18/18

PAGE 1

FINAL CLEARANCE (AGGRESSIVE TEM)

SECTION 028200 01420

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

AIR MONITORING:

To determine if the elevated airborne fiber counts encountered during abatement operations have been reduced to the specified level, the **ENGINEER** will secure samples and analyze them according to the following procedures.

AGGRESSIVE SAMPLING:

Air Samples from Work Areas will be collected using aggressive sampling techniques at locations determined by the **CONSULTANT** as follows:

Before sampling pumps are started, the exhaust from forced air equipment (leaf blower with electric motor) will be swept against walls, ceilings, floors, ledges and other surfaces in the Work Area.

Fans will be mounted in central locations directed toward ceilings and operated at low speed continuously for the period of sample collection to maintain fiber suspension as determined by the **CONSULTANT**.

SCHEDULE OF AIR SAMPLES:

General: The number and volume of air samples taken and analytical methods used by the **CONSULTANT** will generally be in accordance with the following schedule. Sample quantities, volumes, and analytical methodologies may vary and will be at the discretion of the **CONSULTANT**.

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TRANSMISSION ELECTRON MICROSCOPY (TEM):

In each homogeneous Work Area or as determined by the **CONSULTANT**, samples will be collected and analyzed as follows:

LOCATION SAMPLED	SCHEDULED NUMBER OF SAMPLES	FILTER MEDIA
Each Work Area	5	Cellulose Ester
Outside of Work Area	5	Cellulose Ester
Field Blank	2	Cellulose Ester
Lab Blank	1	Cellulose Ester

Analysis: Asbestos fibers on each filter will be measured using analysis per AHERA rules (40 CFR 763, appendix A and B).

Release Criteria: Decontamination of the Work site is complete as determined by the analytical protocol if the average fiber concentration of the Work Area samples is below seventy (70) structures per square millimeter in accordance with 40 CFR 763.90(4). The **CONSULTANT** may elect at his option to utilize the Z-test clearance alternative described in 40 CFR Part 763 in lieu of the above Method.

If the results of analysis of the Work Area samples fails to meet the release criteria, then the decontamination is incomplete and re-cleaning per Section 01580 is required.

Laboratory Testing: Samples will be sent for analysis by Transmission Electron Microscopy to a laboratory selected by the **OWNER** for Twenty-four (24) Hour turn-around.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279

10/18/18

PAGE 1

FINAL CLEARANCE (STATIC PCM)

SECTION 028200 01430

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

AIR MONITORING:

To determine if airborne fiber levels following abatement operations have been reduced to acceptable standards, the **CONSULTANT** will secure and analyze air samples in accordance with the following procedures.

STATIC SAMPLING:

Air Samples from Work Areas will be collected using static sampling techniques at locations determined by the **CONSULTANT**.

SCHEDULE OF AIR SAMPLES:

General: The number and volume of air samples taken and analytical methods used by the **CONSULTANT** will generally be in accordance with the following schedule. Sample quantities, volumes, and analytical methodologies may vary and will be at the discretion of the **CONSULTANT**.

In each homogeneous Work Area or as determined by the **CONSULTANT**, samples will be collected and analyzed as follows:

LOCATION SAMPLED	SCHEDULED NUMBER OF SAMPLES	FILTER MEDIA
Each Work Area	5	Cellulose Ester
Outside of Work Area	5	Cellulose Ester

Analysis: Fibers on each filter will be measured using the NIOSH 7400 procedures.



License No. 10-5279
10/18/18

SECTION 028200.01430
FINAL CLEARANCE (STATIC PCM)
PAGE 2

Release Criteria: Final Clearance (Static PCM) of the Work Area is complete when every Work Area sample is below 0.01 fibers per cubic centimeter or the current Base Line level, whichever is greater.

Re-cleaning: If the results of analysis of the Work Area samples fails to meet the release criteria, Final Clearance is incomplete, re-cleaning per Section 01580 is required, and re-testing is required until release criteria is met.

LABORATORY TESTING: The **CONSULTANT** will be employed by the **OWNER** to perform laboratory analysis of the air samples.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)



License No. 10-5279

10/18/18

PAGE 1

TEMPORARY CONTAINMENT

SECTION 028200 01500

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

PART 2 - PRODUCTS

Plastic Sheeting: A single polyethylene film in the largest sheet size possible to minimize seams, 4 or 6 mils thick as indicated, translucent or opaque, as indicated.

Fire Retardant Plastic Sheeting: When working near hot equipment, in fire potential area, or otherwise required provide flame resistant polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films.

Reinforced Plastic Sheeting: Provide nylon-reinforced, laminated polyethylene film.

Spray Plastic: Provide spray plastic in aerosol cans or premixed for spray application which is formulated to adhere gently to surfaces and remove cleanly by peeling off at the completion of the Work. Use of spray plastic must be approved in advance by the **CONSULTANT**.

Adhesive Tape: Provide adhesive tape in 2" or 3" widths as indicated or required, with an adhesive which is formulated to aggressively stick to sheet polyethylene and other surfaces in a wet, humid, hot environment.

Spray Adhesive: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene, and other surfaces in a wet, humid, hot environment. Use only on surfaces not scheduled to be salvaged, or on surfaces which can be cleaned of the spray adhesive.

Window: Provide 1/4" thick, 18" x 24" minimum clear plastic window(s) to be located to provide view into each Containment Area at location as directed by the **CONSULTANT**.

Paint: Provide luminescent paint capable of adhering to sheet polyethylene in a wet, humid, hot environment.



License No. 10-5279
10/18/18

SECTION 028200.01500
TEMPORARY CONTAINMENT
PAGE 2

PART 3 - EXECUTION

SEQUENCE OF WORK:

Carry out work of this section sequentially. Complete each activity before proceeding to the next, except as may be modified by the **CONSULTANT** to meet Project conditions.

ALTERNATE METHODS OF CONTAINMENT:

Alternate methods of containing the Work Area may be submitted to the **CONSULTANT** for review in accordance with procedures set forth in Section 01360. Do not proceed with any such method(s) without prior approval of the **CONSULTANT**.

WARNING SIGNAGE:

Provide Warning Signs in English and Spanish meeting regulatory requirements generally reading as follows:

Signage shall be placed at approaches to the Work Area at such positions that personnel will have adequate time to take precautions. Post signage so as to not be in view of the general public inside or outside of the building.

Post preliminary signs in public areas reading similar to "CAUTION - CONSTRUCTION AREA - KEEP OUT". Provide visual barriers between preliminary signs and required signage as necessary to prevent undue public view of required signage.

TEMPORARY FACILITIES:

Provide temporary facilities per Section 01380, including temporary disconnection or isolation of existing electrical systems within the abatement work areas.

WORKER PROTECTION:

Provide Worker Protection per Section 01700.

RESPIRATORY PROTECTION:

Provide Respiratory Protection per Section 01710.

VENTILATION SYSTEM:

Provide Ventilation System per Section 01530.



License No. 10-5279
10/18/18

SECTION 028200.01500
TEMPORARY CONTAINMENT
PAGE 3

CRITICAL BARRIERS:

Decontaminate Surfaces in areas to receive Critical Barriers with a HEPA vacuum and by wet wiping (if surface can be wet wiped) per Section 01510 prior to installation of Critical Barriers.

Completely Separate the Work Area from other portions of the building and/or the exterior with plastic sheeting, 4 mil (min) thickness, sealing perimeter and seams with adhesive tape and/or spray adhesive.

Individually seal ventilation openings, wall mounted fixtures, doorways, windows, and other openings into the Work Area with adhesive tape or with plastic sheeting 6 mil (min) thickness secured in place with adhesive tape.

Maintain seal until Work, including Final Clearance, is completed. Exercise care in sealing active lighting and other fixtures to avoid melting or burning of plastic sheeting. Provide ventilation for equipment, such as electrical transformers, as necessary.

Provide plastic sheeting barriers at least 4 mil in thickness as required to completely seal openings from the Work Area into adjacent areas. Seal the perimeter and seams of plastic sheeting barriers with adhesive tape.

PRE-CLEANING (DECONTAMINATION):

Decontaminate wall, floor and ceiling surfaces, within the Work Area with a HEPA vacuum and by wet wiping (if surface can be wet wiped) per Section 01510.

Decontaminate furniture, carpeting, fixtures, equipment, and/or supplies within the Work Area with a HEPA vacuum and by wet wiping (if surface can be wet wiped) per Section 01510, prior to being moved or covered. Decontamination of interior surfaces of enclosed cabinets, drawers, equipment, etc, is not required, unless otherwise indicated.

CARPET:

Cover Carpeting (where occurs) with a minimum of one (1) additional layer of 6 mil plastic sheeting to protect carpeting as critical barrier if carpeting is to remain in place during Work.

DECONTAMINATION UNITS:

Provide Decontamination Units per Section 01520.

CONTAINMENT BARRIERS:

Provide Containment Barriers on surfaces that are not scheduled to be removed .



License No. 10-5279

10/18/18

SECTION 028200.01500
TEMPORARY CONTAINMENT
PAGE 4

Provide two (2) layers of plastic sheeting Containment Barriers on floor areas to remain intact until removed.

Cover floor of Work Area with a minimum of two (2) individual layers of plastic sheeting, 6 mil (min) each, turned up walls at least twelve (12) inches. Form a sharp right angle bend at junction of floor and wall so that there is no radius which could be stepped on causing the wall attachment to be pulled loose. Seal seams using both spray adhesive and adhesive tape.

Locate seams in top layer at a minimum of six (6) feet from, or at right angles to, seams in bottom layer. Install plastic sheeting so that top layer can be removed independently of bottom layer.

Provide one (1) layer of plastic sheeting Containment Barriers on wall and ceiling areas to remain intact until removed.

Cover walls and ceilings in Work Area with a minimum of one (1) layer of plastic sheeting, 4 mil (min), supported as required to maintain barrier intact. Seal perimeters and seams, including the joining with the floor sheeting, with spray adhesive and adhesive tape.

Provide two (2) layers of plastic sheet containment barriers on walls for acoustical plaster or fireproofing removal.

Emergency Exits: At each existing door and opening from the Work Area, provide the following means for emergency exiting. Arrange exit door so that it is secure from outside the Work Area but permits exiting from the Work Area. Mark outline of door on Containment Barriers with luminescent paint or tape at least one inch (1") wide. Hang a razor knife suitable for cutting through the Containment Barriers on a string beside outline. Tape or paint with luminescent paint the word "EXIT" inside the outline in letters at least six inches (6") high and one inch (1") wide.

View Windows: Provide a twelve (12) inch square by 1/8 inch thick (min) clear plastic view window or windows into Containment areas to allow view to full extent possible. Locate as directed by the **CONSULTANT**.

Drop Cloth: Provide on the floor and wall areas as a Drop Cloth a single layer of plastic sheeting (6 mil on floor, 4 mil on wall) in Work Areas during removal operations. Turn floor Drop Cloth up walls at least eighteen (18) inches. Form a sharp right angle bend at junction of floor and wall so that there is no radius which could be stepped on causing the wall attachment to be pulled loose. Overlap wall Drop Cloth twelve (12) inches at floor. Seal seams using both spray adhesive and adhesive tape.

Install Drop Cloth at the beginning of each work shift. Drop cloth need only to be sufficient coverage for work of that shift.



License No. 10-5279
10/18/18

SECTION 028200.01500
TEMPORARY CONTAINMENT
PAGE 5

Remove Drop Cloth at end of each work shift or as work in an area is completed. Fold Drop Cloth toward center of sheet and dispose with fungi (mold) contaminated material.

Keep material on sheet continuously wet until bagged.

Install Walkways of 6 mil plastic sheeting between active removal areas and decontamination units to protect Containment Barriers from tracked material. Install walkways at the beginning of, and remove at the end of each work shift.

EXTENSION OF WORK AREA:

If the Containment Barrier is breached in any manner that could allow the passage of debris or airborne fibers, then add the affected area to the Work Area and provide Temporary Containment as required by this Section.



License No. 10-5279
10/18/18

PAGE 1

PRE-CLEANING AND DECONTAMINATION PROCEDURES SECTION 028200 01510

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF THE WORK:

The Work includes decontamination of areas prior to construction of Temporary Containment.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

RESPIRATORY AND WORKER PROTECTION:

Provide Worker Protection per Section 01700.

Provide Respiratory Protection per Section 01710.

WET CLEANING (WET WIPING):

Accomplish wet cleaning during decontamination with **lint-free towels** (paper or disposable rags).

Wipe surface once and re-fold to a fresh face of cloth. Proceed in this manner until available faces of towel have been used.

Dispose of towel as contaminated waste.

HEPA VACUUM PROCEDURES:

Clean small areas of debris using the following procedures:

Remove small debris with the HEPA vacuum.

HEPA vacuum surfaces of pieces too large to be removed by the suction of the HEPA vacuum.

Pick up such pieces and place in the bottom of a Disposal Bag.

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License No. 10-5279
10/18/18

SECTION 028200.01510
PRE-CLEANING AND DECONTAMINATION PROCEDURES
PAGE 2

Place pieces in the bag without dropping and avoiding unnecessary disturbance of material.

Remove remaining visible debris with HEPA vacuum.

HEPA vacuum an area three (3) feet beyond the location in which visible debris was found. Vacuum in two directions each at right angles to the other.

Clean wall, ceiling, and floor surfaces using the following procedures:

HEPA vacuum surfaces in the room starting with the ceiling, then vacuum starting at the top of walls and working downward to the floor. Next begin at the corner of floor farthest from Work Area entrance and work towards entrance.

HEPA vacuum the floor using a floor attachment with rubber floor seals and adjustable floor to attachment height.

Adjust the height so that the rubber seals just touch the floor if carpeted and are within 1/16" of hard surface floors.

Vacuum the floor in parallel passes with each pass overlapping the previous by one half the width of the floor attachment. At the completion of one cleaning, vacuum the floor a second time at right angles to the first.



License No. 10-5279
10/18/18

PAGE 1

DECONTAMINATION UNITS

SECTION 028200 01520

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF WORK:

Provide personnel and equipment decontamination facilities.

PART 2 - PRODUCTS

Plastic Sheeting: A single polyethylene film in the largest sheet size possible to minimize seams, 4 or 6 mils thick as indicated, translucent or opaque, as indicated.

Fire Retardant Plastic Sheeting: When working near hot equipment, in fire potential area, or otherwise required provide flame resistant polyethylene film that conforms to requirements set forth by the National Fire Protection Association Standard 701, Small Scale Fire Test for Flame-resistant Textiles and Films.

Reinforced Plastic Sheeting: Provide nylon-reinforced, laminated polyethylene film.

Spray Plastic: Provide spray plastic in aerosol cans or premixed for spray application which is formulated to adhere gently to surfaces and remove cleanly by peeling off at the completion of the Work. Use of spray plastic must be approved in advance by the **CONSULTANT**.

Adhesive Tape: Provide adhesive tape in 2" or 3" widths as indicated or required, with an adhesive which is formulated to aggressively stick to sheet polyethylene and other surfaces in a wet, humid, hot environment.

Spray Adhesive: Provide spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene, and other surfaces in a wet, humid, hot environment. Use only on surfaces not scheduled to be salvaged, or on surfaces which can be cleaned of the spray adhesive.

Shower Pan: Provide one piece waterproof shower pan fabricated from seamless fiberglass, stainless steel with welded seams, or other system acceptable to the **CONSULTANT**.



License No. 10-5279
10/18/18

SECTION 028200.01520
DECONTAMINATION UNITS
PAGE 2

Shower Walls and Roof: Provide walls and roof fabricated from impervious, waterproof material. Structurally support as necessary for stability.

Shower Head and Controls: Provide a factory made, personal use, commercial shower head producing a spray of water which can be adjusted for spray size and intensity. Feed shower with water mixed from hot and cold supply lines. Arrange so that control of water temperature, flow rate, and shut off is made from inside the shower without outside aid.

Filters: Provide cascaded filter units on drain lines from showers or other water source carrying contaminated water from the Work Area. Provide units with disposable filter elements as indicated below. Connect so that discharged water passes primary filter and output of primary filter passes through secondary filter.

Primary Filter - Pass particles 20 microns and smaller

Secondary Filter - Pass particles 5 microns and smaller

Lumber: Provide kiln dried lumber of any grade or species.

Sump Pump: Provide totally submersible waterproof sump pump with integral float switch. Provide unit sized to pump two (2) times the flow capacity of showers or hoses supplying water to the sump, through filters loaded to the extent that replacement is required. Provide unit capable of pumping debris, sand, plaster or other materials washed off during decontamination procedures without damage to mechanism of pump. Adjust float switch so that a minimum of 3" remains between top of liquid and top of sump pan.

Disposable Decontamination Unit: The **CONTRACTOR** may provide, as an option, disposable Decontamination Units fabricated utilizing corrugated cardboard or other non-cleanable materials. Units shall be disposed with fungi (mold).

PART 3 - EXECUTION

CONSTRUCTION:

Walls and Ceiling: Construct airtight walls and ceiling using plastic sheeting, 6 mil (min) in thickness. Attach to existing building components or to a temporary framework.

Floors: Use a minimum of two (2) layers of plastic sheeting, 6 mil (min) in thickness, to cover floors (including under shower pan). Use only translucent or clear plastic sheeting to cover floors.

Curtained Doorways: Fabricate from two (2) overlapping layers of plastic sheeting with openings a minimum of three feet (3') wide. Configure so that sheeting overlaps adjacent surfaces. Weight sheets at bottom so that they quickly close after being released. Put arrows on

sheets to indicate direction of overlap and/or travel. Provide a minimum of four feet (4') between entrance and exit of any room. Attach top and right side of outer sheet to doorway frame. Attach top and left side of inner sheet to doorway frame.

Ceiling: If the decontamination unit is located within an area with workers overhead, provide the top of the unit with a minimum 1/4 inch hardboard or 1/2 inch plywood "ceiling" with plastic sheeting, 6 mil (min) in thickness, covering the top of the "ceiling".

Visual Barrier: Where the decontamination unit is within view of occupied areas, provide a visual barriers of opaque plastic sheeting or other suitable material so that worker privacy is maintained and work procedures are not visible to building occupants.

Solid Barrier: Where the area adjacent to the decontamination unit is accessible to building occupants, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with wood or metal framing covered with minimum of 1/4 inch thick hardboard or 1/2 inch plywood. Where a solid barrier is provided, sheeting need not be opaque.

Alternate methods of providing decontamination facilities may be submitted to the **CONSULTANT** for review. Do not proceed with alternate method(s) without authorization of the **CONSULTANT**.

PERSONNEL DECONTAMINATION UNIT:

General: Provide a Personnel Decontamination Unit consisting of a serial arrangement of connected rooms or spaces, with a minimum of a Changing Room, Air Lock Space, Shower Room, Air Lock Space and Equipment Room.

Require persons, without exception, to pass through this Decontamination Unit for entry into and exiting from the Work Area.

Do not allow parallel routes for entry or exit.

Provide temporary lighting within Decontamination Units as necessary.

Electrical: Provide control panel at Changing Room or other outside location to accommodate **CONTRACTOR**'s equipment. Provide complete ground-fault circuit protection for electrical service from control panel, and in accordance with applicable regulations.

Emergency Numbers: Post clearly in Changing Room (Clean Room) the telephone numbers and locations of emergency services including, but not limited to, fire, ambulance, doctor, hospital, police, power company, telephone company.

Signs: Post an approximately twenty inch by fourteen inch (20" x 14") manufactured danger sign at each entrance to the Work Area displaying the following general legend, and as required by applicable regulations.

Changing Room (Clean Room): Provide a room that is physically and visually separated from the rest of the building for the purpose of changing into protective clothing.

Locate so that access to Work Area from Changing Room is through Shower Room.

Separate Changing Room from other building areas by curtained doorway.

Require workers to remove street clothes in this room, dress in clean disposable coveralls, and don respiratory protection equipment.

Do not allow fungi (mold) contaminated items to enter this room.

An existing room may be utilized as the Changing Room if it is suitably located and of a configuration whereby workers may enter the Changing Room directly from the Shower Room. Protect surfaces of such Changing Room with plastic sheeting similar to Containment Barriers as set forth in Section 01500. Authorization for this configuration must be obtained from the **CONSULTANT** prior to start of Work.

Maintain floor of Changing Room dry and clean at all times.
Damp wipe surfaces after each shift change with a disinfectant solution.

Provide a continuously adequate supply of disposable bath towels.

Provide storage facilities per employee as required with additional facilities for **CONSULTANT** and anticipated visitors.

Shower Room: Provide a completely watertight operational shower to be used for transit by cleanly dressed workers heading for the Work Area from the Changing Room, or for showering by workers headed out of Work Area after undressing in the Equipment Room.

Construct room by providing a Shower Pan and Shower Walls in a configuration that will cause water running down walls to drip into pan.

Provide Shower Head and Controls at convenient location securely attached to shower wall.

Provide splash-proof entrances to Changing and Equipment Rooms with two (2) curtained doorways.

Provide hot and cold water and drainage, as necessary for a complete and operable shower. Provide adequate hot water supply for number of persons using shower facilities.

Provide a freely draining floor in shower pan at minimum one (1) inch from top of pan.

Provide a soap and shampoo dish and a continuously adequate supply of soap and shampoo, and maintain in a sanitary condition.

Arrange so that water from showering does not splash into the Changing or Equipment Rooms.

Provide Sump Pump to pump waste water through filters to drain.

Change filters as necessary to maintain efficiency.

Clean debris from shower pans on a daily basis.

Equipment Room (Dirty Room): This is a change and transit area for workers. Separate this room from the Work Area by a plastic sheeting curtained doorway. Require work equipment, footwear and additional contaminated work clothing to be left in Equipment Room.

Provide Drop Cloth per Section 01500 in Equipment Room for each shift. Remove and dispose of Drop cloth after each shift.

Wet wipe surfaces in Equipment Room after each shift change.

Disposable Decontamination Unit: Disposable units shall be utilized at one location per containment and then disposed with fungi (mold) contamination. Moving a disposable unit from one location to another is prohibited.

PERSONNEL DECONTAMINATION SEQUENCE:

Entering Work Area:

Worker shall enter Changing Room, remove street clothing, put on clean disposable overalls and respirator, and pass through the Shower Room into the Equipment Room.

Additional clothing and equipment left in Equipment Room needed by the worker shall be put on in the Equipment Room.

Worker shall then proceed to Work Area.

Exiting Work Area:

Before leaving the Work Area, require the worker to remove gross contamination and debris from overalls and feet. The worker shall then proceed to the Equipment Room and remove disposable clothing. Removed disposable clothing shall be placed in a disposal bag for disposal. Respiratory protection equipment shall not be removed.

Refer to Section 01700 for Shower Room decontamination procedures.

After showering, the worker shall proceed to the Changing Room and dress in either new coveralls for another entry or street clothes if leaving.

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License No. 10-5279
10/18/18

SECTION 028200.01520
DECONTAMINATION UNITS
PAGE 6

EQUIPMENT (BAG-OUT) DECONTAMINATION UNITS:

General: The **CONTRACTOR** may provide an Equipment and Bag-out Decontamination Unit consisting of a serial arrangement of rooms (Wash Down Station, Wash Room, Holding Room, Clean Room) for removal of equipment and material from Work Area. Personnel shall not enter or exit Work Area through Equipment Decontamination Unit.

Wash Down Station: Provide an enclosed completely watertight shower unit located in the Work Area just outside Wash Room as an equipment, bag and container cleaning station.

Construct shower by providing a Shower Pan and Shower Walls in a configuration that will cause water running down walls to drip into pan.

Provide suitable type of fixtures and controls for washing equipment, bags and containers.

Provide splash-proof entrance to Work Area with curtained doorway.

Provide a freely draining floor in shower pan at minimum one (1) inch from top of pan.

Provide Sump Pump to pump waste water through filters to drain. Change filters as necessary to maintain efficiency.

Clean debris from shower pans on a daily basis.

Wash Room (Dirty Room): Provide Wash Room for cleaning of equipment, bags and containers passed from the Work Area. Construct Wash Room of adequate size and located so that equipment, bags and containers, can be wiped clean and passed to the Holding Room. Separate this room from the Wash Down Station by a curtained doorway.

Holding Room: Provide Holding Room as a drop location for equipment, bags and containers passed from the Wash Room. Size and locate so that equipment, bags and containers cannot be passed directly from the Wash Room through the Holding Room to the Clean Room. Separate Holding Room from the adjacent rooms by curtained doorways.

Clean Room: Provide Clean Room to isolate the Holding Room from the building or exterior. Size and locate to provide access to the Holding Room. Separate Clean Room from the building or exterior by a curtained doorway.



License No. 10-5279
10/18/18

SECTION 028200.01520
DECONTAMINATION UNITS
PAGE 7

EQUIPMENT (BAG-OUT) DECONTAMINATION SEQUENCE:

Remove equipment, bags and containers from the Work Area through the Equipment Decontamination Unit according to the following procedure:

At Wash Down Station, thoroughly wash equipment, bags and containers and pass items into Wash Room.

At Wash Room, wet clean equipment, bags and containers per Section 01510 and pass items into Holding Room. Workers shall not enter the Holding Room from the Wash Room.

Enter Holding Area from Clean Room and remove decontaminated items through the Clean Room. Workers shall not enter the Wash Room from the Holding Room.

CLEANING OF DECONTAMINATION UNITS:

Clean debris and residue from inside of Decontamination Units on a daily basis. Wet wipe or wash surfaces when necessary to maintain sanitary conditions.

If the Changing Room of the Personnel Decontamination Unit or the Clean Room or Holding Room becomes contaminated, abandon the Decontamination Unit and erect a new Decontamination Unit. The former Unit may be used as an inner section of the new "Dirty Room".

VENTILATION SYSTEM

SECTION 028200 01530

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

PART 2 - PRODUCTS

VENTILATION UNITS:

General: Supply adequate number of air filtration exhaust ventilation units. Each unit shall include the following:

Cabinet: Constructed of steel or other durable materials able to withstand damage from rough handling and transportation. Provide cabinet widths to accommodate doorways. Cabinet shall be factory sealed to prevent material from being released during use, transport, or maintenance. Access to and replacement of air filters shall be from intake end. Unit shall be mounted on casters or wheels.

Fans: Rate capacity of fan according to usable air-moving capacity under actual operating conditions. Use centrifugal-type fan.

HEPA Filters: The final filter shall be a HEPA type. Provide filter media folded into closely pleated panels. Completely seal the filter media edges with a structurally rigid frame. A continuous rubber gasket shall be located between the filter and the filter housing to form a tight seal.

Each filter shall be individually tested and certified by the manufacturer to have an efficiency of not less than 99.97 % when challenged with 0.3 um dioctyl phthalate (DOP) particles. Testing shall be in accordance with Military Standard Number 282 and Army Instruction Manual 136-300-175A. Each filter shall bear a UL586 label to indicate ability to perform under specified conditions.

Each filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of the air flow.

Pre-filters, which protect the final filter by removing the larger particles, are required to prolong the operating life of the HEPA filter. Two stages of pre-filtration are required. The first-stage prefilter shall be a low-efficiency type (e.g., for particles 10 um and larger). The second-stage (or intermediate) filter shall have a medium efficiency (e.g., effective for particles down to 5 um).

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Pre-filters and intermediate filters shall be installed either on or in the intake grid of the unit and held in place with special housings or clamps.

Instrumentation: Each unit shall be equipped with a Magnehelic gauge or manometer to measure the pressure drop across filters and indicate when filters have become loaded and need to be changed.

A table indicating the usable air-handling capacity for various static pressure readings on the Magnehelic gauge shall be affixed near the gauge for reference, or the Magnehelic reading indicating at what point the filters should be changed, noting Cubic Feet per Minute (CFM) air delivery at that point.

Provide units equipped with an elapsed time meter to show the total accumulated hours of operation.

Safety and Warning Devices: Each unit shall have an electrical (or mechanical) lockout to prevent fan from operating without a HEPA filter. Units shall be equipped with an automatic shutdown system to stop fan in the event of a major rupture in the HEPA filter or blocked air discharge.

Warning lights are required to indicate normal operation, excess pressure drop across the filters (i.e., filter overloading) and inadequate pressure drop (i.e., major rupture in HEPA filter or obstructed discharge).

Electrical components shall be approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL). Each unit shall be equipped with overload protection sized for the equipment. The motor, fan, fan housing, and cabinet shall be grounded.

PART 3 - EXECUTION

GENERAL:

The following is intended to provide a satisfactory reduced air pressure and ventilation rate in the Work Area.

PRESSURE DIFFERENTIAL:

Provide a fully operational ventilation system within the Work Area maintaining continuously a pressure differential across Work Area containment of 0.02 inches of H₂O.

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PREPARATION OF THE WORK AREA:

Determining ventilation requirements: Provide a sufficient number of fully operational ventilation units to provide the equivalent of a minimum of one air change every twelve (12) minutes, within the contained Work Area. Determine total ventilation requirement in cubic feet per minute (cfm) for the Work Area by dividing area volume by the air change rate.

$$\text{Ventilation Requirement (CFM)} = \frac{\text{Volume of Work Area (cu.ft.)}}{12 \text{ (min)}}$$

Determining number of units needed by dividing the ventilation requirement (CFM) above by capacity of ventilation unit(s) used. Capacity of a unit for purposes of this section is the capacity in cubic feet per minute with fully loaded filters (pressure differential at which loaded filter warning lights activate) indicated on the unit's labeled operating characteristics.

$$\text{Number of Units} = \frac{\text{Ventilation Requirement (CFM)}}{\text{Capacity of Unit with Loaded Filters (CFM)}}$$

Location of Ventilation Units: Locate ventilation unit(s) so that makeup air enters Work Area primarily through decontamination facilities and traverses Work Area as much as possible. Position the ventilation unit(s) at a maximum distance from the worker access opening or other makeup air sources.

Place exhaust end of unit or exhaust duct through an opening in the containment barrier or wall. Thoroughly seal opening against unit or duct.

Vent to exterior of building, unless authorized otherwise by the **CONSULTANT**. As necessary, provide additional lengths of flexible or rigid duct connected to the exhaust end of unit and routed to the nearest exterior opening.

Auxiliary Makeup Air Inlets: Provide where required for proper air flow through the Work Area in locations approved by the **CONSULTANT** by making openings in the plastic sheeting that allows air from outside the Work Area into the Work Area.

Locate auxiliary makeup air inlets as far as possible from the ventilation unit(s), off the floor, preferably near the ceiling, and away from barriers that separate the Work Area from occupied areas. Cover with flaps to reseal automatically if the ventilation system should shut down for any reason. Spray flap and around opening with spray adhesive so that flap seals if closed.

If makeup air is coming from a contaminated or potentially contaminated source, provide a HEPA filter at intake before air enters Work Area. Provide supply air fans to overcome the resistance of the HEPA filter as necessary. A ventilation unit may be used for this purpose. Calculations for air change requirements shall accommodate force makeup air to insure that Work Area remains under reduced air pressure.



License No. 10-5279
10/18/18

SECTION 028200.01530
VENTILATION SYSTEM
PAGE 4

OPERATION OF VENTILATION SYSTEM:

Electrical Service: Provide adequate electrical service to ventilation units. Provide separate overload protection devices to each unit such that an overload on one unit will not trip devices of other units in operation.

Testing the System: Test ventilation system prior to start of removal operations. Demonstrate successful operation of ventilation system to **CONSULTANT** during Prep Inspection per Section 01400.

Demonstration of the Operation of the ventilation system to the **CONSULTANT** shall include, but not to be limited to, the following:

Containment Barriers moving lightly in toward Work Area.

Curtained doorways of decontamination units moving lightly in toward Work Area.

Noticeable movement of air through the decontamination unit.

Measurement of the reduced air pressure.

Modify the Ventilation System as necessary to successfully demonstrate the above to the satisfaction of the **CONSULTANT**.

Operation of System during Abatement:

Operate system continuously to maintain a constant reduced air pressure until decontamination of the Work Area is complete. Do not turn off units at the end of the work shift or when abatement operations temporarily stop. If failure of ventilation system occurs, immediately stop abatement work and do not resume until system is fully operating.

Operate system continuously during encapsulating procedures.

Start removal work at a location farthest from the ventilation units and proceed toward the units.

At completion of removal work, allow ventilation system to operate to purge the Work Area with clean makeup air and to remove airborne fibers that may have been generated during removal work.

Operate system continuously until **CONSULTANT** authorizes shut down after successful Final Clearance Air Testing.

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License No. 10-5279
10/18/18

SECTION 028200.01530
VENTILATION SYSTEM
PAGE 5

Dismantling the System:

Before removal of units from the Work Area, remove and dispose of pre-filters as fungi (mold) contaminated, clean and seal unit intake and exhaust openings with 6 mil plastic sheeting, decontaminate exterior of units and seal entire unit, except rolling assembly, with 6 mil plastic sheeting.

REMOVAL OF ASBESTOS-CONTAINING MATERIALS

SECTION 028200 01540

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUBMITTALS:

Include manufacturer's data and disposal plan for proposed use of Over-sized Disposal Bags in the Plan of Action, Section 01000:

PART 2 - PRODUCTS

PLASTIC SHEETING, ADHESIVE TAPE, etc: Refer to Section 01500.

WETTING AGENTS:

Amended Water: Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the ACM and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

Removal Encapsulant: Provide a penetrating type encapsulant designed specifically for removal of ACM. Use a material which results in wetting of the ACM and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five gallons of water.

DISPOSAL BAGS: Provide single layer, 6 mil (min) thickness, leak-tight, manufactured polyethylene bags. Provide bags with DOT marking ARQ, ASBESTOS, NA 2212" and diamond shaped figure with black stripes on top half and A9" on the bottom half.

DISPOSAL CONTAINERS: Provide manufactured rigid plastic or coated cardboard drums or boxes, leak-tight, with mechanically sealed lids specifically intended for disposal of asbestos-containing waste materials. Containers manufactured to meet more stringent disposal requirements will be acceptable.

DISPOSAL BAG LABELS: Provide labels with **OWNER's** name, Project site address and the following warning, and in accordance with regulatory requirements.

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
AVOID BREATHING AIRBORNE ASBESTOS

PART 3 - EXECUTION

TEMPORARY CONTAINMENT:

Provide Temporary Containment per Section 01500.

GENERAL REMOVAL CRITERIA (GROSS REMOVAL):

Apply wetting agents in strict accordance with manufacturer's instructions.

Thoroughly wet material to be removed prior to disturbance to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of wetting agent (amended water or removal encapsulant) applied with airless spray equipment. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow adequate time for wetting agent to penetrate material thoroughly. Spray material repeatedly during the removal work to maintain a continuously wet condition.

Perforate outer covering of material which has been painted or jacketed in order to allow penetration of wetting agent, or where necessary, carefully strip away while simultaneously spraying amended water or removal encapsulant on the installation to minimize dispersal of asbestos fibers into the air.

Mist work area continuously with amended water as necessary to reduce airborne fiber levels. Apply mist with airless spray equipment.

The use of compressed air or other non-airless type equipment will not be permitted.

Remove saturated material in manageable quantities. Do not allow material to dry out.

Control the descent to staging or floor below. If over twenty (20) feet use drop chute to contain material through descent.

Thoroughly clean substrate, removing remaining residue using stiff bristled brush, pressure washer, or combination of methods to provide effective results.

PIPE INSULATION REMOVAL:

Wet and remove material as indicated above.

Cut bands holding preformed pipe insulation, slit jackets at seams, remove and hand-place in a disposal bag. Do not drop to floor.

Remove job molded fitting insulation in pieces as large as practical and hand place in a disposal bag. Do not drop to floor.

Where pipefitting insulation is removed from pipe with straight runs insulated with fibrous glass or other non-asbestos-containing fibrous material, remove fibrous material six (6) inches from the point of contact with the asbestos-containing insulation and seal exposed ends of remaining pipe insulation.

CEMENT FIBER BOARD REMOVAL:

Wet and remove material as indicated above.

Remove material in full panels, as practical, using care not to break panels.

Place panels in disposal bags, containers or wrap with two (2) layers of plastic sheeting, 6 mil (min) in thickness, and label as required.

DISPOSAL BAG PROCEDURE:

Place removed material while still in wet condition into disposal bags.

Evacuate air from disposal bags with a HEPA vacuum before sealing.

Twist neck of bags, bend over and seal with minimum three (3) wraps of adhesive tape.

Clean outside of bags and move to decontamination unit.

Place second bag around first immediately prior to moving through decontamination unit. Evacuate air, twist neck, and seal the second bag in the same manner as the first.

Wash bags in shower, wet clean, and pass cleaned bags to adjacent room.

Attach label to each disposal bag as indicated and in accordance with regulatory requirements.

Dispose of labeled bags per Section 01590.

DISPOSAL CONTAINER PROCEDURE:

Place removed material while still in wet condition into disposal containers. Seal containers securely.

Clean outside of containers and move to decontamination unit.

Wash containers in shower, wet clean, and pass cleaned containers to adjacent room.

Attach label to each container as indicated and in accordance with regulatory requirements.

Dispose of labeled containers per Section 01590.

REMOVAL OF MECHANICAL EQUIPMENT INSULATION SECTION 028200 01548

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUBMITTALS:

Include manufacturer=s data and disposal plan for proposed use of Over-sized Disposal Bags in the Plan of Action, Section 01000.

PART 2 - PRODUCTS

PLASTIC SHEETING, ADHESIVE TAPE, ETC.:

Refer to Section 01500.

WETTING AGENTS:

Amended Water: Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the ACM and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five (5) gallons of water.

Removal Encapsulant: Provide a penetrating type encapsulant designed specifically for removal of ACM. Use a material which results in wetting of the ACM and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five (5) gallons of water.

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DISPOSAL BAGS:

Provide single layer, 6 mil (min) thickness, leak-tight, manufactured polyethylene bags. Provide bags with required DOT marking ARQ, ASBESTOS, NA 2212" and diamond shaped figure with black stripes on top half and A9" on the bottom half.

DISPOSAL CONTAINERS:

Provide manufactured rigid plastic or coated cardboard drums or boxes, leak-tight, with mechanically sealed lids specifically intended for disposal of asbestos-containing waste materials. Containers manufactured to meet more stringent disposal requirements with be acceptable.

DISPOSAL BAG LABELS:

Provide labels with OWNER's name, Project site address and the following warning, and in accordance with regulatory requirements.

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
AVOID BREATHING AIRBORNE ASBESTOS

PART 3 - EXECUTION

TEMPORARY CONTAINMENT:

Provide Temporary Containment per Section 01500. Do not place plastic sheeting on materials to be removed.

GENERAL REMOVAL CRITERIA (GROSS REMOVAL):

Apply wetting agents in strict accordance with manufacturer=s instructions.

Thoroughly wet material to be removed prior to disturbance to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of wetting agent (amended water or removal encapsulant) applied with airless spray equipment. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow adequate time for wetting agent to penetrate material thoroughly. Spray material repeated during the removal work to maintain a continuously wet condition.

Perforate outer covering of material which has been painted or jacketed in order to allow penetration of wetting agent, or where necessary, carefully strip away while simultaneously spraying amended water or removal encapsulant on the installation to minimize dispersal of asbestos fibers into the air.

Mist work area continuously with amended water as necessary to reduce airborne fiber levels. Apply mist with airless spray equipment/

The use of compressed air or other non-airless type of equipment will not be permitted.

Remove saturated material in manageable quantities. Do not allow material to dry out.

Control the descent to staging floor below. If over twenty (20) feet use drop chute to contain material during descent.

Thoroughly clean substrate, removing remaining residue using stiff bristled brush, pressure washer or combination of methods to provide effective results.

DISPOSAL BAG PROCEDURE:

Place removed material while still in wet condition into disposal bags.

Evacuate air from disposal bags with a HEPA vacuum before sealing.

Twist neck of bags, bend over and seal with a minimum of three (3) wraps of adhesive tape.

Clean outside of bags and move to decontamination unit.

Place second bag around first immediately prior to moving through decontamination unit. Evacuate air, twist neck, and seal the second bag in the same manner as the first.

FLFYA

License No. 10-5279
10/18/18

SECTION 028200.01548
REMOVAL OF MECHANICAL EQUIPMENT INSULATION
PAGE 4

Wash bags in shower, wet clean, and pass cleaned bags to adjacent room.

Attach label to each disposal bag as indicated and in accordance with regulatory requirements.

Dispose of labeled bags per Section 01590.

DISPOSAL CONTAINER PROCEDURE:

Place removed material while still in wet condition into disposal containers. Seal containers securely.

Clean outside of containers and move to decontamination unit.

Wash containers in shower, wet clean, and pass cleaned containers to adjacent room.

Attach label to each container as indicated and in accordance with regulatory requirements.

Disposes of labeled containers per Section 01590.



License No. 10-5279
10/18/18

PAGE 1

REMOVAL OF PIPE INSULATION

SECTION 028200 01549

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUBMITTALS:

Include manufacturer=s data and disposal plan for proposed use of Over-sized Disposal Bags in the Plan of Action, Section 01000.

PART 2 - PRODUCTS

PLASTIC SHEETING, ADHESIVE TAPE, ETC.:

Refer to Section 01500.

WETTING AGENTS:

Amended Water: Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the ACM and retardation of fiber release during disturbance of the material equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five (5) gallons of water.

Removal Encapsulant: Provide a penetrating type encapsulant designed specifically for removal of ACM. Use a material which results in wetting of the ACM and retardation of fiber release during disturbance of the material equal to or greater than that provided by water amended with a surfactant consisting of 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with five (5) gallons of water.

DISPOSAL BAGS:

Provide single layer, 6 mil (min) thickness, leak-tight, manufactured polyethylene bags. Provide bags with required DOT marking ARQ, ASBESTOS, NA 2212" and diamond shaped figure with black stripes on top half and A9" on the bottom half.

DISPOSAL CONTAINERS:

Provide manufactured rigid plastic or coated cardboard drums or boxes, leak-tight, with mechanically sealed lids specifically intended for disposal of asbestos-containing waste materials. Containers manufactured to meet more stringent disposal requirements with be acceptable.

DISPOSAL BAG LABELS:

Provide labels with OWNER's name, Project site address and the following warning, and in accordance with regulatory requirements.

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
AVOID BREATHING AIRBORNE ASBESTOS

PART 3 - EXECUTION

TEMPORARY CONTAINMENT:

Provide Temporary Containment per Section 01500. Do not place plastic sheeting on materials to be removed.

GENERAL REMOVAL CRITERIA (GROSS REMOVAL):

Apply wetting agents in strict accordance with manufacturer-s instructions.

Thoroughly wet material to be removed prior to disturbance to reduce fiber dispersal into the air. Accomplish wetting by a fine spray (mist) of wetting agent (amended water or removal encapsulant)) applied with airless spray equipment. Saturate material sufficiently to wet to the substrate without causing excess dripping. Allow adequate time for wetting agent to penetrate material thoroughly. Spray material repeated during the removal work to maintain a continuously wet condition.

Perforate outer covering of material which has been painted or jacketed in order to allow penetration of wetting agent, or where necessary, carefully strip away while simultaneously spraying amended water or removal encapsulant on the installation to minimize dispersal of asbestos fibers into the air.

Mist work area continuously with amended water as necessary to reduce airborne fiber levels. Apply mist with airless spray equipment.

The use of compressed air or other non-airless type of equipment will not be permitted.

Remove saturated material in manageable quantities. Do not allow material to dry out.

Control the descent to staging floor below. If over twenty (20) feet use drop chute to contain material during descent.

Thoroughly clean substrate, removing remaining residue using stiff bristled brush, pressure washer or combination of methods to provide effective results.

DISPOSAL BAG PROCEDURE:

Place removed material while still in wet condition into disposal bags.

Evacuate air from disposal bags with a HEPA vacuum before sealing.

Twist neck of bags, bend over and seal with a minimum of three (3) wraps of adhesive tape.

Clean outside of bags and move to decontamination unit.

Place second bag around first immediately prior to moving through decontamination unit. Evacuate air, twist neck, and seal the second bag in the same manner as the first.

Wash bags in shower, wet clean, and pass cleaned bags to adjacent room.

Attach label to each disposal bag as indicated and in accordance with regulatory requirements.

Dispose of labeled bags per Section 01590.

DISPOSAL CONTAINER PROCEDURE:

Place removed material while still in wet condition into disposal containers. Seal containers securely.

Clean outside of containers and move to decontamination unit.



License No. 10-5279
10/18/18

SECTION 028200.01549
REMOVAL OF PIPE INSULATION
PAGE 4

Wash containers in shower, wet clean, and pass cleaned containers to adjacent room.

Attach label to each container as indicated and in accordance with regulatory requirements.

Disposes of labeled containers per Section 01590.



License No. 10-5279
10/18/18

PAGE 1

REMOVAL OF PIPE INSULATION (GLOVE-BAG METHOD) SECTION 028200 01550

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF THE WORK:

Removal of asbestos-containing piping insulations within containment by the Glove-bag method.

PART 2 - PRODUCTS

PLASTIC SHEETING, ADHESIVE TAPE, etc:

Refer to Section 01500.

WETTING AGENTS:

Refer to Section 01540.

GLOVE-BAG:

Provide minimum 6 mil polyethylene, or equivalent plastic sack, with two sealed inward projecting long-sleeved gloves or mittens, pre-printed with same warning notice as a disposal bag, equipped with a pouch for storage of tools, with designated location for wand or HEPA vacuum wand, and sufficient capacity to hold removed materials and permit proper sealing. Utilize vertical glove-bags for removal of vertical pipe insulations.

SPRAYER:

Provide a hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or spray of liquid under pressure.

PART 3 - EXECUTION

TEMPORARY CONTAINMENT:

Provide Temporary Containment per Section 01500, with the following exception:



License No. 10-5279
10/18/18

SECTION 028200.01550
REMOVAL OF PIPE INSULATION (GLOVE-BAG METHOD)
PAGE 2

Containment Barriers: The **CONTRACTOR** may, at his option provide a single layer containment barrier on the floor in lieu of the two (2) layers indicated in Section 01500.

REMOVAL OF PIPE INSULATION (GLOVE-BAG METHOD):

Inspect pipe insulation in the area to be removed. Wrap damaged pipe insulation (broken lagging, hanging, etc) with plastic sheeting and secure with adhesive tape in a "candy-stripe" pattern.

Place one layer of adhesive tape around undamaged pipe insulation at each end where the Glove-bag will be attached.

Slit top of the Glove-bag open (if necessary) and cut down the sides to accommodate the size of the pipe insulation (approximately two (2) inches longer than the pipe insulation diameter).

Place necessary tools into pouch located inside Glove-bag.

Place one strip of adhesive tape along the edge of the open top slit of Glove-bag for reinforcement.

Place the Glove-bag around the section of pipe insulation, then staple top slit together through reinforcing adhesive tape.

Apply adhesive tape at the ends of the Glove-bag to the pipe insulation where previously covered with adhesive tape.

Test seal using smoke tube and aspirator bulb. Place tube into water sleeve (two-inch opening to Glove-bag) squeezing bulb and filling bag with visible smoke. Remove smoke tube and twist water sleeve closed. While holding the water sleeve tightly, gently squeeze Glove-bag and inspect for smoke leaks. If leaks occur, tape close using adhesive tape and re-test.

Insert wand from garden sprayer through water sleeve. Adhesive tape water sleeve tightly around the wand to prevent leakage.

Thoroughly wet insulation with wetting agent and allow to soak in. Wet adequately to penetrate and soak material through to substrate. Keep insulation continuously wet throughout remainder of removal process.

Cut insulation at each end of the section to be removed. Make cuts neat and square if remaining insulation is not scheduled for subsequent removal.

Remove insulation using tools as necessary. Place pieces in bottom of bag without dropping.

Rinse tools with wetting agent inside the bag and place back into pouch.

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License No. 10-5279
10/18/18

SECTION 028200.01550
REMOVAL OF PIPE INSULATION (GLOVE-BAG METHOD)
PAGE 3

Using scrub brush, rags and wetting agent, scrub and wipe down the exposed pipe.

Remove water wand from water sleeve and attach nozzle from HEPA vacuum. Operate vacuum only as necessary to collapse the bag.

Remove the vacuum nozzle, twist water sleeve closed and seal with adhesive tape.

From outside the bag, pull the tool pouch away from the bag. Place adhesive tape over twisted portion and then cut the tool bag from the Glove-bag, cutting through the twisted-taped section. Contaminated tools may then be placed directly into next Glove-bag without cleaning.

Alternatively, tools may be decontaminated and removed from Work Area. Dispose of rags and scrub brush as ACM.

With removed insulation in the bottom of the bag, twist the bag repeatedly and apply adhesive tape to keep material in the bottom during removal of the Glove-bag from the pipe.

Slip a disposal bag over the Glove-bag (still attached to the pipe). Remove tape or cut Glove-bag, open top of the Glove-bag and fold Glove-bag down into disposal bag.

Collapse disposal bag using HEPA vacuum, twist neck of bag, seal with minimum three (3) wraps of adhesive tape, bend over and seal again with minimum three (3) wraps of adhesive tape.

Seal exposed ends of remaining pipe insulation at completion of removal work.



License No. 10-5279
10/18/18

PAGE 1

REMOVAL OF PIPE INSULATION IN CRAWLSPACE

SECTION 028200 01555

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

PART 2 - PRODUCTS

SOIL ENCAPSULANT:

Provide soil encapsulant, with a tinted coloring agent, as selected by the **CONSULTANT** from Manufacturers standard colors, specifically designed for application to soils after removal. Manufacturers offering products in compliance with this section include:

International Protective Coatings Corp. - Serpiloc
Certified Technologies Corp. - Certane 2050

PLASTIC SHEETING, ADHESIVE TAPE, etc:

Refer to Section 01500.

WETTING AGENTS:

Refer to Section 01540.

GLOVE-BAG:

Provide minimum 6 mil polyethylene, or equivalent plastic sack, with two sealed inward projecting long-sleeved gloves or mittens, pre-printed with same warning notice as a disposal bag, equipped with a pouch for storage of tools, with designated location for wand or HEPA vacuum wand, and sufficient capacity to hold removed materials and permit proper sealing. Utilize vertical glove-bags for removal of vertical pipe insulations.

SPRAYER:

Provide a hand pump type pressure-can garden sprayer fabricated out of either metal or plastic, equipped with a metal wand at the end of a hose that can deliver a stream or spray of liquid under pressure.

FLJY

License No. 10-5279
10/18/18

SECTION 028200.01555
REMOVAL OF PIPE INSULATION IN CRAWLSPACE
PAGE 2

PART 3 - EXECUTION

TEMPORARY CONTAINMENT:

Provide Temporary Containment, including Critical Barriers, per Section 01500, with the following exception:

Containment Barriers are not required.

REMOVAL PROCEDURE:

Remove debris and soil to levels indicated in Section 01560.

Provide two (2) coats of soil encapsulant to soil area.

Provide one layer of six (6) mil polyethylene on soil area within four feet each side of pipe insulation scheduled to be removed and along pathways to be used within the Work Area. (Complete polyethylene enclosure or containment around pipe is not required.)

Install Glove-bags on pipe areas to be removed. Remove pipe insulation utilizing Glove-bag Method per Section 01550. Properly bag and remove materials from Work Area, including polyethylene on soil. Provide bridging ("lock-down") encapsulant to pipe and soil areas immediately below pipe.

At completion of removal, allow ventilation system to operate in Work Area for twelve (12) hours minimum. Maintain Work Area in undisturbed condition throughout this period.

FINAL AIR CLEARANCE:

Final Air Clearance samples will be analyzed by Static PCM Method.



License No. 10-5279
10/18/18

PAGE 1

REMOVAL OF ASBESTOS-CONTAMINATED SOIL

SECTION 028200 01560

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

PART 2 - PRODUCTS

SOIL ENCAPSULANT:

Provide soil encapsulant, with a tinted coloring agent, as selected by the **CONSULTANT** from Manufacturers standard colors, specifically designed for application to soils after removal. Manufacturers offering products in compliance with this section include:

International Protective Coatings Corp. - Serpiloc
Certified Technologies Corp. - Certane 2050

PLASTIC SHEETING, ADHESIVE TAPE, etc:

Refer to Section 01500.

WETTING AGENTS:

Refer to Section 01540.

DISPOSAL BAGS:

Refer to Section 01540.

PART 3 - EXECUTION

TEMPORARY CONTAINMENT:

Provide Temporary Containment, including Critical Barriers, per Section 01500, with the following exception:

Containment Barriers are not required.

REMOVAL PROCEDURE:

Saturate soil with amended water or a removal encapsulant as specified in Section 01540. Saturate soil beyond the thickness of soil being removed.

Maintain the surface of the soil continuously wet throughout removal. Arrange ventilation system so that air flow is the starting point of work toward the entrance.

Remove and dispose of the top three (3) inches of soil.

A vacuum loader may be utilized.

If utilizing hand removal methods in lieu of vacuum loader, remove soil in one (1") inch increments, keeping soil moist with removal encapsulant.

After removing soil to required depth, **CONTRACTOR** shall remove remaining visible debris.

After completion of removal, apply two (2) coats of soil encapsulant.

Apply one coat of lock-down encapsulant to grade beams, piers, floor framing, etc.



License No. 10-5279
10/18/18

PAGE 1

REMOVAL OF TEMPORARY CONTAINMENT

SECTION 028200 01580

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUMMARY:

This section describes procedures following the removal of indicated **ACM** to the completion of abatement activities, including removal of temporary containment, equipment, supplies, and temporary facilities from the Project site.

SUBMITTALS:

Indicate clearly on submittals finishes or coatings (if any), which may be incompatible with proposed encapsulant.

PRODUCT DELIVERY:

Deliver products per section 01370, and include the following information: name or title of materials, manufacturer's stock number and date of manufacture, thinning instructions and application instructions.

Deliver products together with a copy of the OSHA Material Safety Data Sheet for the material.

PART 2 - PRODUCTS

ENCAPSULANTS (LOCK-DOWN):

Provide penetrating or bridging type encapsulants specifically designed for use with asbestos containing materials and for application to intended substrates.

Provide encapsulant suitable to receive painted or acoustical finishes.

Fire Safety: Use only materials that have a flame spread index of less than twenty-five (25), when dry, when tested in accordance with ASTM E-84.



License No. 10-5279
10/18/18

SECTION 028200.01580
REMOVAL OF TEMPORARY CONTAINMENT
PAGE 2

PART 3 - EXECUTION

GROSS REMOVAL:

Work of this Section begins at completion of gross removal Work.

PRE-ENCAPSULATION PROCEDURES:

Remove all but the bottom most layer of the Containment Barriers.

Decontaminate surfaces of remaining Containment Barriers with a HEPA vacuum and by wet wiping per Section 13510.

LOCK-DOWN ENCAPSULATION:

Apply encapsulant in strict accordance with the manufacturer's instructions, including requirements for environmental conditions in the Work Area.

Utilize airless spray equipment with air pressure and nozzle orifice as recommended by the encapsulant manufacturer.

Do not apply excessive coating to cause drips, runs, or thickened build-up of material.

Do not apply encapsulant to mechanical and electrical equipment, moving parts, gauges, glass and similar surfaces.

Allow encapsulant to dry thoroughly, minimum of four (4) hours, before proceeding.

PRE-FINAL CLEARANCE PROCEDURES:

Remove Containment Barriers.

Decontaminate exposed surfaces of Work Area, which visually exhibit debris or water contamination with a HEPA vacuum and by wet wiping per Section 01510.

POST-FINAL CLEARANCE PROCEDURES:

Remove Critical Barriers.

Decontaminate exposed surfaces of Work Area, which visually exhibit debris or water contamination with a HEPA vacuum and by wet wiping per Section 01510.



License No. 10-5279
10/18/18

SECTION 028200.01580
REMOVAL OF TEMPORARY CONTAINMENT
PAGE 3

Remove Ventilation System.

Remove Decontamination Units.

Decontaminate exposed surfaces at removed Decontamination Units, which visually exhibit debris or water contamination with a HEPA vacuum and by wet wiping per Section 01510.



License No. 10-5279
10/18/18

PAGE 1

DISPOSAL OF ASBESTOS-CONTAINING WASTE MATERIAL SECTION 028200 01590

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUMMARY:

Asbestos-containing waste material shall be disposed as indicated and in accordance with Federal, State, and Local disposal regulations.

The **CONTRACTOR** shall provide for waste materials storage, loading, vehicles and equipment, transport, off-loading, and other necessary items of Work associated with disposal of asbestos-containing waste.

DISPOSAL FEES:

The **CONTRACTOR** shall pay disposal fees associated with the Work.

SUBMITTALS:

Submit proposed transporter and landfill prior to start of Work. Transporter and Landfill must be acceptable to the **CITY**. If either is unacceptable the **CONTRACTOR** shall provide an acceptable substitution.

Submit evidence of fee payment no later than initial payment request.

Submit waste manifests to the **CITY** for review and signature a minimum of twenty-four (24) hours in advance of proposed transport. Submit via hand delivery or courier.

Submit copies of waste manifests and landfill receipts to the **CONSULTANT** on a weekly basis.

PART 2 - PRODUCTS

STORAGE CONTAINER:

Provide fully enclosed, metal, lockable storage container (dumpster) for temporary storage of **ACM** waste material on the Project site, if at **CONTRACTOR's** option, temporary storage is to be employed.

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Line entire storage container with a single layer of plastic sheeting, 6 mil (min) in thickness. Install in a like manner to Containment Barriers per Section 01500.

Locate storage container in area designated by the CITY.

A vehicle meeting requirements of storage container may be use for temporary storage of ACM waste material.

TRANSPORT VEHICLE:

Provide fully enclosed, lockable storage section on transport vehicle used for transport of ACM waste material.

Line entire storage area of transport vehicle with a single layer of plastic sheeting, 6 mil (min) in thickness. Install in a like manner to Containment Barriers per Section 01500.

VEHICLE WARNING SIGN:

Provide a warning sign for each vehicle used to transport asbestos-containing waste materials in accordance with regulatory requirements and include the following legend:

DANGER
ASBESTOS DUST HAZARD
CANCER AND LUNG DISEASE HAZARD
Authorized Personnel Only

PART 3 - EXECUTION

BAG-OUT PROCEDURES:

Remove disposal bags or containers from the Decontamination Unit and carefully load directly into Storage Container or Transport Vehicle.

Provide visual barriers (minimum: opaque plastic sheeting) to obstruct the view of bag-out operations from areas outside the CONTRACTOR's designated area.

Do not store ACM waste material outside of the Work Area except in Storage Container as indicated.

FLJYJ

License No. 10-5279
10/18/18

SECTION 028200.01590
DISPOSAL OF ASBESTOS-CONTAINING WASTE MATERIAL
PAGE 3

TRANSPORT:

Attach warning sign to vehicles during the loading and unloading of **ACM** waste material. Sign shall remain visible during loading and unloading activities.

Exercise care before and during transport, to insure that no unauthorized persons have access to the waste material.

Advise the **CITY** and **CONSULTANT**, a minimum of seventy-two (72) hours in advance, of intended transport and quantity of material involved.

Carefully off-load bags or containers by hand at the landfill site.

If bags or containers are broken or damaged, decontaminate intact bags or containers per Section 01510, place each damaged bag or container, including debris in two (2) new, clean undamaged bags or a container in the same manner as originally placed, and decontaminate vehicle storage area per Section 01510. Dispose of vehicle lining and cleaning materials and supplies as **ACM**. Retain receipts from landfill for disposed materials.



License No. 10-5279
10/18/18

PAGE 1

WORKER PROTECTION

SECTION 028200 01700

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUMMARY:

This Section describes clothing, equipment and procedures for protection of workers during asbestos abatement activities.

Refer to Section 01710 for Respiratory Protection.

WORKER TRAINING:

Provide worker training for workers on the Project in accordance with applicable regulations. Worker training shall be maintained current for the Project Duration.

MEDICAL EXAMINATIONS:

Provide medical examinations for workers on the Project in accordance with applicable regulations, including OSHA requirements as set forth in 29 CFR 1926.1001 (m). Worker medical examinations shall be maintained current for the Project Duration.

LICENSING\REGISTRATION:

Provide appropriate licensing\registration, including state photo identification, for workers on the Project in accordance with applicable regulations. Worker licensing\registration shall be maintained current for the Project Duration.

SUBMITTALS:

General: Submit the following documentation to the **CONSULTANT** for review. Submit in a timely fashion to allow completed review of documentation prior to start of Work. Workers whose documentation is unreviewed, incomplete, expired or otherwise unsatisfactory as determined by the **CONSULTANT** will not be permitted to engage in asbestos abatement activities on the Project. If a document expires during the course of the Project, the affected worker(s) will not be permitted to engage in asbestos abatement activities on the Project until a satisfactory current document has been submitted and reviewed by the **CONSULTANT**.



License No. 10-5279
10/18/18

SECTION 028200.01700
WORKER PROTECTION
PAGE 2

List of Workers: Submit a list of **CONTRACTOR**'s personnel (typewritten or neatly printed) for the Project. Only **CONTRACTOR**'s personnel on the list will be permitted on the Project site. Post a copy of the list at the entry to the Work Area. Update the list on a daily basis.

Certificate of Worker's Acknowledgment: Submit an original signed copy of the Certificate of Worker's Acknowledgment, found at the end of this section, for each person on the List of Workers.

Worker Training Certificate: Submit evidence of required Worker Training.

Medical Examination Results: Submit copy of required Medical Examination results.

Worker Registration Certificate: Submit evidence of required Worker Licensing and Registration.

Respiratory Fit Test Certificate: Submit evidence of Respiratory Fit Test for the type of respirator proposed for Work, and in accordance with applicable regulations.

PART 2 - PRODUCTS

PROTECTIVE CLOTHING AND EQUIPMENT:

General: Provide protective clothing and equipment as required by applicable regulations for anticipated type of Work.

Coveralls: Provide disposable full-body coveralls, foot covers, and disposable head covers of polyolefin or polypropylene. Require that the above be worn continuously by personnel in the Work Area. Provide a sufficient number for required changes for workers, the **CONSULTANT** and visitors in the Work Area. Non-disposable or cloth protectives will not be permitted.

Gloves: Provide durable waterproof work gloves to workers and require that gloves be worn continuously by personnel in the Work Area. Do not remove gloves from work area; dispose as contaminated waste.

Boots and Shoes: Provide waterproof boots or shoes to be used in the Work Area. Provide boots or shoes with non-skid soles and hard toes.

Hard Hats: Provide head protectives (hard hats) for workers as applicable for anticipated type of Work. Provide four (4) spare hard hats for use by the **CONSULTANT** and visitors. Label hats with same warning labels as used on disposal bags. Require hard hats to be worn when Work is in progress. Provide hard hats with plastic strap style of suspension. Require hats to remain in the Work Area throughout the Work. Decontaminate Prior to removing from Work Area or dispose of hard hats as contaminated waste.



License No. 10-5279
10/18/18

SECTION 028200.01700
WORKER PROTECTION
PAGE 3

Goggles: Provide eye protectives (goggles) for workers involved in chipping, scraping, spraying, or other activity which may potentially cause eye injury.

PART 3 - EXECUTION

WORKER PROTECTION:

General: Provide for protection of workers and other authorized personnel on the Project site as required by applicable regulations for anticipated type of Work.

The following procedures are to be considered minimum regardless of air monitoring results within the Work Area.

Require that protective clothing and equipment be worn continuously in Work Area. Replace damaged or torn items immediately.

ENTERING WORK AREA:

Each time Work Area is entered, remove street clothes in the Changing Room of the Personnel Decontamination Unit and don new disposable coverall, head and foot covers and gloves. Tape gloves to the sleeves of coveralls.

Fit proper respiratory protection (respirator).

Proceed through Shower Room to Equipment Room. Don work boots or shoes, hard hat, goggles, etc in Equipment Room.
Proceed to Containment area.

WITHIN WORK AREA:

Workers shall not eat, drink, smoke, chew gum or tobacco in the Work Area.

Workers shall not remove protective clothing or equipment within the Work Area.

EXITING WORK AREA:

Decontamination Procedures: Require personnel to adhere to the following decontamination procedures when exiting the Work Area.

Remove disposable clothing and equipment (except respirator) in the Equipment Room.

Proceed to Shower Room still wearing respirator. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos contamination while showering.

Thoroughly wet body including hair and face.

If using PAPR, exercise care to prevent water from entering canisters, blower unit and battery pack.

If using half or full face cartridge type respirator (non-powered), exercise care to prevent water from entering cartridges at this point.

With respirator remaining in place, thoroughly wash body, hair, and parts of the respirator with soap/shampoo.

Carefully wash seal between face and respirator and under straps.

Take a deep breath, hold and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove respirator away from face before breathing.

Carefully wash respirator inside and out. Dispose of wet filters as contaminated waste.

If using PAPR: Shut down in the following sequence; first, cap inlets to filter cartridges; then turn off blower unit (this sequence will help keep debris which has collected on the inlet side of filter from dislodging and contaminating the outside of the unit). Thoroughly wash blower unit and hoses. Carefully wash battery pack with wet rag. Use caution to prevent water entering the battery pack.

Rinse body and respirator thoroughly.

Rinse Shower Room walls and floor prior to exit.

Proceed from shower to Changing Room and change into street clothes or into new disposable work items.

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME _____
PROJECT ADDRESS _____ DATE _____
CONTRACTOR _____

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's Contract with the OWNER for the above project requires that: You be supplied with the proper respirator and be trained in its use. You be trained in safe work practices and in the use of the equipment found on the job. You receive a medical examination. These things are to have been done at no cost to you. By signing this certification you are assuring the OWNER that your employer has met these obligations to you.

RESPIRATORY PROTECTION: I have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. I have a copy of the written respiratory protection manual issued by my employer. I have been equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: I have been trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. The topics covered in the course included the following:

- Physical characteristics of asbestos
- Health hazards associated with asbestos
- Respiratory protection
- Use of protective equipment
- Ventilation systems
- Work practices including hands-on or on-job training
- Personal decontamination procedures
- Air monitoring, personal and area

MEDICAL EXAMINATION: I have had a medical examination within the last 12 months which was paid for by my employer. This examination included: health history, pulmonary function tests and may have included an evaluation of a chest X-ray.

I further agree to hold the OWNER and the OWNER's Consultants harmless from any and all claims for asbestos or other claims I may have.

Signature _____
Printed Name _____
Social Security Number _____
Witness _____

FLJ

License No. 10-5279
10/18/18

SECTION 028200.01700
WORKER PROTECTION
PAGE 6

CERTIFICADO DE CONOCIMIENTO DEL TRABAJADOR:

(CERTIFICATE OF WORKER'S ACKNOWLEDGMENT - Spanish)

NOMBRE DEL PROYECTO _____

DOMICILIO DEL PROYECTO _____ FECHA _____

NOMBRE DEL CONTRATISTA _____

TRABAJAR CON ASBESTOS PUEDE SER PELIGROSO. EL RESPIRAR FIBRAS DE ASBESTOS A SIDO ASOCIADO CON VARIOS TIPOS DE CANCER. SI TU FUMAS Y RESPIRAS FIBRAS DE ASBESTOS, LAS POSIBILIDADES DE DESARROLLAR CANCER EN LOS PULMONES SON MAYORES QUE EN LAS PERSONAS QUE NO FUMAN.

El contrato de trabajo de tu patron con el dueño de este proyecto requiere que: se te debe proporcionar un respirador apropiado y se te enseñe como usarlo. Tu debes ser entrenado para trabajar con medidas de seguridad y se te enseñe a usar el equipo y herramienta que se requiere para trabajar. Que seas examinado por un medico. Estas cosas deben ser hechas sin costo alguno para ti. Al firmar este certificado tu estas asegurando al dueño del proyecto que tus patrones ya cumplieron con estas obligaciones (de proporcionarte equipo adecuado, entrenarte en practicas de seguridad y pasar por un chequeo medico). Por lo que se esta de acuerdo en mantener al dueño del proyecto, sus consejeros, laboratorio de analisis y sus representantes fuera de responsabilidad en todas y cada una de las quejas que puedan resultar de, o relacionadas con este proyecto.

PROTECCION RESPIRATORIA: Yo he sido entrenado en el use apropiado de respiradores, y he sido informado del tipo de respirador que debe ser usado en este proyecto. Yo tengo una copia escrita del manual de proteccion respiratoria proporcionado por mis patrones. Yo he sido equipado sin costo alguno para me con el respirador que debe ser usado en este proyecto.

CURSO DE ENTRENAMIENTO: Yo he sido entrenado en los peligros relacionados con el manejo de asbestos y con el respirar polvo de asbestos y he sido entrenado en los procedimientos de trabajo adecuados y medidas de proteccion personales en el area de trabajo. Los temas vistos en el curso incluyen los siguientes:

- | | |
|---|---|
| Caracteristicas fisicas de asbestos | Practicas de trabajo mientras se trabaja o se entrena |
| Peligros de salud asociado con asbestos | Procedimientos de descontaminacion personal |
| Uso de equipo de proteccion | Muestreo del aire, personal y del area |
| Sistemas de aire negatives | |

EXAMEN MEDICO: Yo he sido examinado dentro de los ultimos 12 meses el cual fue pagado por mis patrones. Esta examinacion incluye: historia de salud, pruebas de funcion pulmonares y podria tener incluida una evaluacion de rayos x del torax.

FIRMA _____

NOMBRE ESCRITO _____

NUMERO DEL SEGURO SOCIAL _____

TESTIGO _____



License No. 10-5279
10/18/18

PAGE 1

RESPIRATORY PROTECTION

SECTION 028200 01710

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

SUMMARY:

This Section describes respiratory protection during asbestos abatement activities.

STANDARDS:

Comply with the following as applicable:

OSHA	U.S. Department of Labor Occupational Safety and Health Administration, Safety and Health Standards 29 CFR 1910, Section 1001 and Section 1910.134, 29 CFR 1926.
CGA	Compressed Gas Association, Inc., New York, Pamphlet G-7, "Compressed Air for Human Respiration", and Specification G-7.1 "Commodity Specification for Air".
CSA	Canadian Standard Association, Rexdal, Ontario, Standard Z180.1-1978, "Compressed Breathing Air".
ANSI	American National Standard Practices for Respiratory Protection, ANSI Z88.2-1980.
NIOSH	National Institute for Occupational Safety and Health
MSHA	Mine Safety and Health Administration

PART 2 - PRODUCTS

AIR PURIFYING RESPIRATORS:

Respirator Bodies: Provide half-face or full-face type respirators; negative pressure or powered (PAPR). Equip full-face respirators with a nose cup or other anti-fogging device as would be appropriate for use in air temperatures less than 32 degrees Fahrenheit.

Provide an extra battery pack for each PAPR.

FLJ

License No. 10-5279
10/18/18

SECTION 028200.01710
RESPIRATORY PROTECTION
PAGE 2

Filter Cartridges: Provide, at a minimum, HEPA type filters labeled with NIOSH and MSHA Certification for "Radionuclides, Radon Daughters, Dust, Fumes, Mists including Asbestos-Containing Dusts and Mists" and color coded in accordance with ANSI Z228.2 (1980).

In addition, a chemical cartridge section may be added, if required, for solvents, etc., in use. In such case, provide cartridges that have each section of the combination canister labeled with the appropriate color code and NIOSH/MSHA Certification.

Non-Permitted Respirators: Do not use single use, disposable or quarter face respirators.

SUPPLIED AIR RESPIRATOR SYSTEMS (TYPE "C"):

General: Provide equipment capable of producing air of quality and volume required as applied to the Project conditions and crew size.

Air Quality: Provide air used for breathing in Type "C" supplied air respiratory systems that meets or exceeds standards set for C.G.A. type 1 (Gaseous Air) Grade D.

Face piece and Hose: Provide full Face piece and hose by same manufacturer, certified by NIOSH/MSHA as an approved Type "C" respirator assembly operating in pressure demand mode with a positive pressure Face piece.

Auxiliary Backup System: In atmospheres which contain sufficient oxygen (greater than or equal to 19.5% oxygen), provide a pressure-demand full Face piece supplied air respirator equipped with an emergency backup HEPA filter.

Escape Air Supply: In atmospheres which are oxygen deficient (less than 19.5% oxygen), provide a pressure-demand full Face piece supplied air respirator incorporating an auxiliary self-contained breathing apparatus (SCBA) which automatically maintains an uninterrupted air supply in pressure demand mode with a positive pressure Face piece.

Backup Air Supply: Provide a reservoir of compressed air located outside the Work Area which will automatically maintain a continuous uninterruptable source of air automatically available to each connected Face piece and hose assembly in the event of compressor shut-down, contamination of air delivered by compressor, power loss or other failure. Provide sufficient capacity in the backup air supply to allow a minimum escape time of one-half hour times the number of connections available to the Work Area. Air requirement at each connection is the air requirement of the respirators in use plus the air requirement of an average sized adult male engaged in moderately strenuous activity.

Warning Device: Provide a warning device that will operate independently of the building's power supply. Locate so that alarm is clearly audible throughout the Work Area and at the compressor with a volume above the noise level produced by equipment and work procedures in use. Connect alarm to warn of:



License No. 10-5279
10/18/18

SECTION 028200.01710
RESPIRATORY PROTECTION
PAGE 3

Compressor shut-down or other fault requiring use of backup air supply,

Carbon Monoxide (CO) levels in excess of 10 PPM/V.

Carbon Monoxide (CO) Monitor: Continuously monitor and record on a strip chart recorder Carbon Monoxide (CO) levels. Place monitors in the air line between compressor and backup air supply and between backup air supply and workers. Connect monitors so that they also sound an alarm as indicated under "Warning Devices".

Compressor Shut-Down: Interconnect monitors, alarms and compressor so that compressor is automatically shut down and the alarms sounded if any of the following occur:

Carbon Monoxide (CO) concentrations exceed 10 PPM/V in the air line between the filter bank and backup air supply.

Compressor temperature exceeds normal operating range.

Compressor Motor: Provide a compressor driven by an electric motor. Insure that electrical supply available is adequate to energize motor.

If building power supply is inadequate or as other factors may necessitate, provide gasoline or diesel compressor motor as follows.

Compressor Location: Locate compressor outside of building in location that will not impede access to the building, and that will not cause a nuisance by virtue of noise or fumes to occupied portions of the building.

Air Intake: Locate air intake remotely from source or automobile exhaust or exhaust from motors, or buildings.

After Cooler: Provide an after cooler at entry to filter system which is capable of reducing temperatures to outside ambient air temperatures.

SELF-CONTAINED BREATHING APPARATUS (SCBA):

Configure system to permit the recharging of 2 hour 6220 PSI SCBA cylinders.

PART 3 - EXECUTION

GENERAL:

Respiratory Protection Program: Comply with ANSI Z88.2 - 1980 "Practices for Respiratory Protection" and OSHA 29 CFR 1910 and 1926, and other applicable regulations.

FLJ

License No. 10-5279
10/18/18

Instruct and train workers in proper care and use of respiratory protection equipment

Require that respiratory protection be used in the Work Area from the start of Work which may cause airborne asbestos fibers until the Work Area is completely decontaminated. Use respiratory protection appropriate for the fiber concentration encountered and anticipated or as required for other toxic or oxygen-deficient situations encountered.

Require that respiratory protection be used during the possibility of disturbance of asbestos-containing materials whether intentional or accidental.

Regardless of Airborne Fiber Concentrations: Require that the minimum level of respiratory protection used be half-face air-purifying respirators with high efficiency filters.

RESPIRATORY PROTECTION FACTOR:

Use the following respiratory protection factors in determining the degree of protection offered by the indicated respirator type between air inside and outside the respirator.

RESPIRATOR TYPE	PROTECTION FACTOR
Air purifying: Negative pressure respirator High efficiency filter Half Face piece	10
Air purifying: Negative pressure respirator High efficiency filter Full Face piece	50
Powered-air purifying (PAPR): Positive pressure respirator High efficiency filter Half or Full Face piece	100
Type C supplied air: Positive pressure respirator Continuous-flow Half or Full Face piece	100

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Type C supplied air: Positive pressure respirator Pressure demand Full Face piece	1000
Type C supplied air: Positive pressure respirator Pressure demand Full Face piece Equipped with an auxiliary positive pressure Self-contained breathing apparatus (SCBA)	Over 1000
<u>Self-contained breathing apparatus (SCBA):</u> <u>Positive pressure respirator</u> <u>Pressure demand filter</u> <u>Full Face piece</u>	<u>Over 1000</u>

MINIMUM TYPE OF RESPIRATORY PROTECTION REQUIRED:

Provide at a minimum the following respiratory protection unless otherwise indicated:

Preparatory, Pre-cleaning, Temporary Containment construction Work: Utilize half-face, negative pressure, air-purifying respirator with high efficiency filters.

Removal Work using Glove-Bag Method: Utilize half-face, negative pressure, air-purifying respirator with high efficiency filters.

Removal Work involving only Resilient Flooring and Mastic: Utilize half-face, negative pressure, air-purifying respirator with high efficiency filters.

Removal Work not in Temporary Containment (such as roofing materials): Utilize half-face, negative pressure, air-purifying respirator with high efficiency filters.

Other Removal Work: Utilize full-face, powered air-purifying respirator (PAPR) with high efficiency filters.

Repair and Maintenance Work: Utilize half-face, negative pressure, air-purifying respirator with high efficiency filters.



License No. 10-5279
10/18/18

SECTION 028200.01710
RESPIRATORY PROTECTION
PAGE 6

SUPPLIED AIR RESPIRATOR SYSTEMS (TYPE "C"):

General: Carefully set up and control supplied air respirator systems to prevent hazards for workers due to difficulty of handling the attached hoses, including on scaffolding and other equipment.

Air Systems Monitor: Monitor the air system operation including compressor operation, filter system operation, backup air capacity and warning and monitoring devices continuously during system operation.

AIR PURIFYING RESPIRATORS:

General: Store respirators and filters in the Changing Room. Store respirators in individual, clean plastic bags. Maintain a sufficient quantity of respirator filters for the Work.

Half or Full Face Negative Pressure Respirators: Require that filters be discarded and that new filters be installed each time a worker exits and re-enters the Work Area.

Powered Air Purifying Respirators (PAPR): Require that filters be discarded and that new filters be installed when flow through the face-piece decreases to the level at which the manufacturer recommends filter replacement. Require that regardless of flow, filters be replaced after forty (40) hours of use. Maintain one spare battery charged or being charged for each PAPR provided.



License No. 10-5279
10/18/18

PAGE 1

DEMOLITION WORK (NON-ACM)

SECTION 028200 02000

SUMMARY

Removal of Non-**ACM** materials (prior to beginning abatement activities) including:

- drywall
- carpet
- doors and frames
- millwork and equipment
- wall finishes
- curtains
- electrical devices, conduit, and wiring in walls

PART 1 - GENERAL

SCOPE OF WORK

Provide labor and materials necessary to accomplish **DEMOLITION WORK** complete and in accordance with the General Conditions of the Contract.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

INSPECTION

Make detailed inspection of Work area prior to beginning.

Verify governing dimensions and other permissible dimensional tolerances.

Report in writing unsatisfactory conditions encountered; do not begin Work until conditions are correct. Beginning Work signifies acceptance of conditions.

PROTECTION

Protect items and materials designated to remain after completion of Project.

Do not disturb ceilings or other identified **ACM** materials in the course of the Work of this Section.

Replace, or repair to the satisfaction of the **OWNER**, elements that become damaged prior to Final Acceptance.

License No. 10-5279
10/18/18

SECTION 028200.02000
DEMOLITION WORK (NON-ACM)
PAGE 2

DEMOLITION

Remove existing construction as indicated.

Dampen materials to minimize dust.

Cut walls approximately 6" below ceilings to avoid disturbance of ceiling materials during Work of this Section. Carefully remove lower portion of wall and dispose of debris. Brace upper portions if require to maintain stability.

Materials which cannot be removed without disturbing **ACM** materials shall be removed as **ACM** in accordance with other parts of this Specification.

CLEANING

Maintain site and Work areas in broom clean condition daily

Dispose of excess materials and debris away from site.

Comply with applicable codes and ordinances regarding waste transportation and disposal.

License No. 10-5279
10/18/18

PAGE 1

NON-ACM BUILDING DEMOLITION

SECTION 028200 02050

SUMMARY

Demolition of structure as Non-**ACM** after completion of abatement activities.

PART 1 - GENERAL

SCOPE OF WORK

Provide labor and materials necessary to accomplish **DEMOLITION WORK** complete and in accordance with the General Conditions of the Contract.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

INSPECTION

Make detailed inspection of Work Area prior to beginning.

Report in writing unsatisfactory conditions encountered; do not begin Work until conditions are correct. Beginning Work signifies acceptance of conditions.

Comply with applicable codes and ordinances regarding demolition, waste transportation and disposal. Obtain required permits as indicated in Section 01200, Codes and Regulations.

PROTECTION

Protect items and materials not indicated for demolition.

Replace, or repair to the satisfaction of the **OWNER**, elements that become damaged prior to Final Acceptance.

Protect active utilities within the Work Area. Coordinate disconnection of utilities with **OWNER** and utility companies. Provide for disconnecting of utilities from structure.

Cap disconnected utilities properly at five feet (5') minimum from building line.



License No. 10-5279
10/18/18

SECTION 028200.02050
NON-ACM BUILDING DEMOLITION
PAGE 2

DEMOLITION

Maintain materials in a condition (wet) to minimize construction dust.

Remove and dispose of existing construction including concrete slab foundation to two feet (2') below grade.

At completion of removal work, level excavated area to smooth grade.

Properly transport and dispose of excess materials and debris away from site.



License No. 10-5279
10/18/18

PAGE 1

REPAIR OF INSULATION AND LAGGING

SECTION 028200 15200

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to the Work of this section.

DESCRIPTION OF WORK:

Repair of insulation on piping upon which asbestos-containing insulation is to remain.

Repair of laggings on boilers, breechings and equipment upon which asbestos-containing lagging and/or insulation is to remain.

Labeling of repaired asbestos-containing materials.

PART 2 - PRODUCTS

Mineral Wool Insulating Cement: Provide job mixed insulating plaster manufactured for use on plumbing equipment.

Waterproof Cement: Provide premixed or job mixed cement manufactured for coating of thermal insulation laggings.

Non-woven Fibrous Glass Mat: Provide felt approximately 3/32" thick fabricated from glass fibers.

Open Weave Glass Fiber Mat: Provide cloth with approximately 1/4" openings in weave, fabricated from glass fibers twisted or braided into strands approximately 1/128" in diameter. Products of different materials, other than specified, may be submitted to the **CONSULTANT** for approval.

PART 3 - EXECUTION

GENERAL:

Piping: Remove any loose material with HEPA vacuum. No existing jacket material is to be removed.

Fill holes with mineral wool insulating cement and cover damaged areas with Non-woven fibrous glass mat completely saturated with bridging type encapsulant.

Wrap open joints with non-woven fibrous glass mat embedded in bridging type encapsulant

FLFYA

License No. 10-5279
10/18/18

SECTION 028200.15200
REPAIR OF INSULATION AND LAGGING
PAGE 2

Smooth mat to a wrinkle-free condition. Allow to dry and coat entire surface of mat with an additional coat of bridging type encapsulant and brush to a smooth uniform appearance.

Fittings: Patch damaged fittings as required, using mineral wool insulating cement. Smooth insulation to a uniform appearance, continuous with and not overlapping adjacent straight insulation runs. Cover entire surface of fitting with Non-woven fibrous glass mat embedded in bridging type encapsulant. Stretch to conform to shape of fitting and smooth to a uniform appearance without wrinkles. Overlap jackets of adjacent straight insulation sections by 3". Allow to dry and coat entire surface of mat with bridging type encapsulant and brush to a smooth finished appearance.

Equipment Laggings: (Hot Water Tanks, Converters, Etc.) Fill damaged portion of lagging as required with mineral wool insulating cement and cover with Non-woven fibrous glass mat completely embedded in bridging type encapsulant. Coat area of repair and six inches on all sides with bridging type encapsulant, brush out to a uniform appearance. Completely coat laggings which do not possess a canvas jacket with two (2) coats of bridging type encapsulant.

Boiler and Smoke Hoods Breeching Laggings: Fill damaged portions of laggings, as required, with mineral wool insulating cement. Coat entire surface or lagging with 1/4" minimum thickness of mineral wool insulating cement reinforced with open-weave glass fiber mat. Trowel surface smooth finish.

Labeling: Label repaired asbestos-containing piping insulation, fitting insulation laggings, etc.

In unoccupied areas label with a 3" x 5" yellow sticker containing the words:

"DANGER - CONTAINS ASBESTOS FIBERS - AVOID BREATHING DUST - BREATHING ASBESTOS MAY CAUSE SERIOUS BODILY HARM."

In occupied areas, provide labels shaped like stop signs approximately 3" across with text reading:

"STOP - Before Doing Work In This Area, See Custodian".

Apply labels minimum two (2) per side of maximum of five feet (5') apart on boilers, breeching and equipment and a minimum of one per section and maximum of eight feet (8') apart on pipe runs.

Apply labels to both sides of pipe runs which are accessible from both sides.

DIVISION 03 THROUGH 06

NOT USED

DIVISION 07

THERMAL AND MOISTURE PROTECTION



OCTOBER 12, 2018

F-12811

Engineered Exteriors, PLLC

SECTION 075020 - MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Preparation of the substrate to receive new roof membrane.
 - 2. New modified bitumen roof membrane, insulation, and base flashings, and sheet metal flashings at areas indicated on the plans.
- B. NOTE: Contractor shall coordinate and verify with the District regarding active roof warranties for the roof areas under this scope of work. If roof is under a current warranty, all roofing work shall be completed by a contractor approved by the manufacturer to install and repair twenty (20) year warranted systems. All roofing materials used in this area shall be provided by or approved in writing by Manufacturer.

1.2 REFERENCES

- A. ASTM D 41: Concrete primer used in roofing, damp proofing, and waterproofing.
- B. ASTM D 4586: Asphalt flashing cement.
- C. ASTM D 6163: Standard specifications for SBS modified bitumen sheet materials using glass fiber reinforcements.
- D. ASTM D 6162: Standard specifications for SBS modified bitumen sheet materials using a combination of polyester and glass fiber reinforcements.
- E. NRCA Roofing & Waterproofing Manual, latest edition
- F. SMACNA Architectural Sheet Metal Manual, latest edition
- G. Membrane Immersion Test: Modified bitumen membrane, asphaltic impregnation evaluation, by membrane manufacturer.

1.3 SUBMITTALS

- A. Submit product data for each component of system to be installed. Include documentation showing compliance with all physical properties specified for the completed system, as well as individual components.
- B. Submit Material Safety Data Sheets on all roofing materials to be used.
- C. Submit with a letter from a minimum of three major roofing materials manufacturers stating that your company has been an approved or certified applicator for a minimum of five (5) years and that your company is approved to install those manufacturers' 20-Year No Dollar Limit (NDL) Guarantee.

1.4 QUALITY ASSURANCE

- A. Work of this section to conform to recommendations of the NRCA Roofing and Waterproofing Manual, latest edition.
- B. Minimum Roofing Contractor Qualifications:
 - 1. Be currently approved and certified to install low slope roof systems that qualify for the submitted roofing material manufacturer's 20-Year No Dollar Limit (NDL) Guarantee; and use only skilled roofers completely familiar with the products and the manufacturer's current recommended methods of installation.
 - 2. Contractor shall maintain a permanent office for conduct of business and shall operate its own full-service sheet metal shop.

1.5 PRE-INSTALLATION CONFERENCE

- A. A pre-installation conference shall be held prior to commencing work of this section. Representatives of the owner, roof consultant, roofing contractor, sub-contractors, and manufacturer must be present.
- B. Review installation procedures, materials to be used, submittals, schedules, and all related work required under this section. Finalize construction schedule and confirm availability of materials, equipment, contractor's personnel, and facilities needed to complete work as planned.
- C. Review forecasted weather conditions and procedures for coping with unfavorable conditions, and maintaining the water tightness of the roof system.
- D. Tour representative areas of roofing substrates, inspect and discuss condition of substrate, roof drains, penetrations, curbs, and any work performed by other trades.
- E. Review structural loading limitations of deck and inspect deck for acceptability as roof substrate.
- F. Review inspection and quality control procedures to be used.
- G. Record discussions of conference, including decisions and agreements reached. Furnish copy of record to each party attending. If disagreements exist at the conclusion of the conference, determine how disagreements will be resolved, and set a date for reconvening conference.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials in accordance with manufacturer's printed instructions. Deliver materials in manufacturer's original wrappers, dry, and undamaged with seals and labels intact. If inside storage is not available at the job site, protect materials by covering with breathable tarpaulins. Polyethylene covers are not acceptable field storage coverings.
- B. Store rolled goods on end on raised platforms, and protected from the weather until installed in the roofing system.
- C. Adhesives, flashing cements, and pail goods must be stored in original containers with lids tightly in place and protected from weather exposure.

- D. Remove products from job site that show indications of moisture damage and replace with undamaged materials.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply roofing materials during inclement weather.
- B. Proceed with roofing work only when existing and forecasted weather conditions will permit the roof system to be installed in accordance with manufacturer's recommendations and guaranty requirements.
- C. Work shall be stopped if moisture is present in any form (snow, water, and dew), or if conditions do not allow the proper application rates of adhesives.
- D. Follow manufacturer's instructions for cold weather installation when applicable.

1.8 AIR QUALITY MEASURES

- A. Temporarily seal air intake facilities near the work area, to prevent fumes, smoke, and odor from entering interior spaces.

PART TWO – PRODUCTS

2.1 MODIFIED BITUMEN ROOF MEMBRANE SYSTEM

- A. General: Install roofing materials according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing.
- B. ACCEPTABLE MANUFACTURERS
 - 1. Johns Manville
 - 2. Firestone Building Products
 - 3. Performance Roof Systems
 - 4. Siplast
 - 5. Soprema
 - 6. GAF
 - 7. Approved Equivalent
- C. Base Ply: SBS torch grade modified bitumen sheet membrane with glass fiber or polyester reinforcing fibers, or a combination of polyester and glass fiber reinforcing.
- D. Top Ply: SBS torch grade modified bitumen cap sheet, fire rated, with the following properties.
- E. Base Flashing Membrane: Minimum two plies, consisting of one ply of torch grade modified bitumen base ply, and one ply of torch grade modified bitumen cap sheet. Both plies shall be applied with adhesive with heat welded laps.

2.3 ACCESSORY MATERIALS

- A. Wood Blocking:
 - 1. Curbs and curb extensions: No. 2 grade yellow pine, standard Douglas Fir, Kiln Dried (KD).
 - 2. Wood Cants: No. 2 Grade Yellow Pine, Standard Douglas Fir.
 - 3. Fasteners:
 - a. Wood Substrate: Stainless steel, common nails, gauge and length to suit application and as necessary to penetrate underlying wood support members a minimum of 1-1/4 inch. Each nail to have a minimum pull out resistance of 100 pounds.
 - b. Metal Substrate: A No. 12 Factory Mutual approved, fluorocarbon coated roofing screw.
- B. Insulation and Coverboard:
 - 1. Fiber Cant: ASTM C728, 5 inch face.
 - 2. Polyisocyanurate Insulation, ASTM C1289, closed cell foam core bonded to fiberglass facers to match thickness of existing roof insulation.
 - 3. Cover Board: DensDeck Prime, Securock as required to match existing thickness.
- C. Insulation Securement:
 - 1. Lightweight Fill Decks: OMG Lite-Deck Fasteners (or approved equivalent), length sufficient to penetrate deck with 2" minimum embedment.
 - a. Shank diameter 0.312" minimum, thread diameter of 0.375" minimum.
 - b. Fastener shall be coated with a corrosion resistant coating. When subjected to 30 Kesternich cycles (DIN 50018), the fastener must show less than 15% red rust and surpass Factory Mutual Approval Standard 4470.
 - 2. Concrete/Metal Decks: A No. 12 Factory Mutual approved, fluorocarbon coated roofing screw, approved by manufacturer for substrate material. At concrete decks, provide length sufficient to penetrate deck 1" minimum. At metal decks, provide length sufficient to penetrate top flute 3/4" minimum.
 - 3. Plates (all substrates): 3" diameter, galvanized steel, as approved by insulation manufacturer.
 - 4. Adhesive: Low rise foam adhesive, as approved by insulation manufacturer.
- D. Asphalt Primer: ASTM D 41, as approved by membrane manufacturer.
- E. Asphalt Roof Cement: Modified Asphalt Roof Cement: Trowel grade modified asphalt adhesive for horizontal and vertical applications, as approved by membrane manufacturer.
- F. Modified Adhesive: SBS modified asphalt adhesive as approved by membrane manufacturer.
- G. Flashing Nails: For wood nailers and curbs, flashing nails shall be 11 gauge, G90 hot dip galvanized, large head Simplex nails with 1" diameter heads and of sufficient length to penetrate the full depth of the nailer. For concrete and masonry substrates, stainless steel case hardened nails for concrete shall be used.
- H. High Temperature, Self Adhered Rubberized Asphalt Membrane: CCW WIP 300 HT, as manufactured by Carlisle Coatings and Waterproofing, or approved equivalent.

- I. Liquid-Applied Reinforced Flashing System: Single-component, PMMA resin with polyester reinforcing fleece fabric fully embedded into the resin to form roof system flashings. Liquid resin, Meets or exceeds ASTM C836.
 1. Resin: Soprema Alsan RS Flashing or approved equivalent.
 2. Non-woven polyester reinforcement: Soprema Alsan Polyfleece or approved equivalent.
 3. Surfacing: Liquid resin with mineral granules broadcast into wet resin.

PART 3- EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with manufacturer's published recommendations for installation of all materials specified in this Section. The manufacturer's current published Installation Manual and Catalog will be considered a part of this specification.
- B. At the end of each day's work, install watertight night seals to protect the new roof system from moisture and to prevent water leaks into the building. Remove night seals prior to starting the next day's work.
- C. Plan the flow of work, equipment, materials, and personnel to eliminate traffic across the completed new roof materials.
- D. Comply with the Austin Independent School District's Project Development Manual.

3.2 PREPARATION

- A. Carefully cut and remove existing roof membrane and insulation to the roof deck surface to allow installation of new equipment curbs. Do not remove excessive amounts of existing roof materials, limit removal to the minimum extent required for proper installation of new curb(s).
- B. Notify Engineer immediately if moisture or deterioration is encountered in the existing roof system materials removed or the existing deck to remain.
 1. Do not install new roofing materials adjacent to or on top of wet and/or damaged substrate.
 2. Remove wet roofing materials and replace to match existing on a unit price basis in accordance with the Contract amounts.
- C. Examine substrates, areas, and conditions for compliance with the following requirements:
 1. Roof openings and penetrations are in place and set and braced.
 2. Equipment curbs in place, provide the specified minimum base flashing height above the finished roof. If inadequate height is provided, install additional nailers below or on top of curbs as necessary to comply.
 3. All surfaces are smooth and free of dirt, debris and incompatible materials (i.e., concrete curing compounds) that will impair adhesion of roofing components.
 4. Remove sharp projections.

5. Deck surfaces are dry. If standing water is present, remove all standing water with blowers prior to commencement of installation. Roof assemblies installed over wet substrates are subject to rejection.
 6. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Provide protection below all equipment and materials (mechanical, electrical, plumbing, and roofing) set on existing roof surfaces during completion of the work. Failure to provide specified protection materials below may result in repairs at Contractor's expense.
1. Minimum protection requirements include installation of both 1" rigid foam insulation board (EPS, polyisocyanurate, or perlite) and 1/2" sheathing (plywood, OSB, gypsum, or wood fiber).
 2. Sheathing boards shall be strapped together and weighted to resist wind uplift if protection area exceeds one 4'x8' board.

3.3 WOOD BLOCKING AND INSULATION

- A. Wood Blocking Installation: Mechanically fasten new wood blocking to existing decks with specified fasteners at twelve inches on center (12" o.c.) minimum, of length to provide minimum embedment required by manufacturer.
- B. Insulation Installation: Adhere new insulation to existing cleaned, prepared surface per manufacturer's instructions. Provide maximum ribbon spacing of four inches (4").

3.4 MODIFIED BITUMEN ROOF SYSTEM

- A. Base Ply Membrane Application:
1. Heat existing granular surfaced membrane and embed all granules.
 2. Heat weld base ply, starting at the low point, laying plies at a right angle, lapping sides minimum of 3 inches and end laps a minimum of 6 inches.
 3. Perform light rolling or brooming promptly to eliminate air pockets, wrinkles, creases, and fishmouths, and to insure proper adhesion.
 4. Prevent foot or vehicle traffic from crossing newly laid base ply sheets until bitumen cools to below softening point.
 5. Extend base ply up four inches (4") minimum above existing roof base flashings. Lap end joints at least 3 inches.
 6. Install base ply continuously in one direction from the field of the roof to the top of the curb.
- B. Application of modified bitumen cap sheet:
1. Offset side laps and end laps from those of the base ply.
 2. Embed cap sheet, starting at the low point, laying plies at a right angle, heat welding to the top face of the base ply sheets, lapping sides minimum of 3 inches and end laps a minimum of 6 inches.
 3. Stagger laps between plies.
 4. Perform light rolling or brooming promptly to eliminate air pockets, wrinkles, creases, and fishmouths, and to insure proper adhesion.
 5. Extend top ply up curb four inches (4") minimum above existing roof membrane flashings. Lap end joints at least 3 inches.

6. Install top ply continuously in one direction from the field of the roof to the top of the curb.
7. Broadcast mineral granules over all bitumen overruns to ensure a monolithic surface color.

3.5 LIQUID-APPLIED, SINGLE-COMPONENT, BITUMEN-URETHANE FLASHING SYSTEM APPLICATION:

- A. Refer to manufacturer's details drawings, product data sheets and published general requirements for application rates and specific installation instructions.
- B. Pre-cut polyester reinforcing fleece to conform to roof terminations, transitions and penetrations being flashed. Ensure a minimum 2 in overlap of fleece at side and end-laps. Ensure the completed liquid-applied flashing membrane is fully reinforced.
- C. Apply the base coat of liquid-applied flashing resin onto the substrate using a brush or roller, working the material into the surface for complete coverage and full adhesion at 2.0 gallons per square.
- D. Immediately apply the reinforcing into the wet base coat of resin. Using a brush or roller, work the into the wet resin while applying the second coat of resin to completely encapsulate the fleece at 2.0 gallons per square, and extend the liquid resin 1 inch beyond the fleece.
- E. Allow the liquid membrane to sufficiently cure for 24 to 48 hours then apply the finish coat of resin at 2.0 gallons per square.
- F. Broadcast mineral granules into the wet finish coat as required to match the adjacent cap sheet.

3.6 PROTECTION AND CLEANING

- A. Protect new roof materials during remainder of construction period. Plan work so traffic over new roof materials is kept to a minimum. Where traffic must continue over new roof system, provide protection for the finished roof as specified in this Section.
- B. Provide protection for masonry and other building surfaces against damage of staining from roofing operations. Any surfaces damaged or stained as a result of roofing operations shall be cleaned, repaired or replaced as necessary by the roofing contractor.
- C. Job site shall be maintained in a clean, orderly fashion, and free of debris. Store materials and equipment so operations of building are not interrupted.

END OF SECTION

SECTION 076000 - SHEET METAL FLASHING AND TRIM

PART I - GENERAL

1.1 WORK INCLUDED

- A. Install flashing and sheet metal as indicated on Drawings and in these specifications as required for a complete and proper installation.

1.2 RELATED WORK

- A. Section 075210 – Modified Bituminous Membrane Roofing

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Describe material profile, jointing pattern, jointing details, fastening methods, and installation details.
- C. Submit samples under provisions of Division 1.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA and NRCA standard details and requirement.

1.5 QUALIFICATIONS

- A. Company specializing in sheet metal flashing work with a minimum of 10-years documented experience.

1.6 STORAGE AND HANDLING

- A. Stack pre-formed materials to prevent twisting, bending, or abrasion, and to provide ventilation.
- B. Prevent contact with materials during storage that may cause discoloration, staining, or damage.
- C. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. Sheet metal flashing:
 - 1. ASTM A653 hot-dipped G90 galvanized steel, 24 gauge. Locations as indicated on the Drawings.
 - 2. ASTM A240 Type 304 stainless steel, 24 gauge. Locations as indicated on the Drawings.

2.2 SHEET METAL SCHEDULE

- A. Penetration curb hoods, closure plates, and counterflashings: 24 galvanized steel.
- B. Counterflashings at equipment curbs: 24 galvanized steel.

2.3 ACCESSORIES

- A. Solder: ANSI/ASTM B 32 50/50 type.
- B. Blind Pop-Rivets: Stainless steel.
- C. Asphalt Primer: ASTM D 41.
- D. Modified Asphalt Roof Cement: Trowel grade modified asphalt adhesive for horizontal and vertical applications.

2.4 SEALANT

- A. Type I: Application exposures to sunlight, ASTM C-920-87, Federal Specification TT-S-00230-C one component gun-grade polyurethane sealant suitable for continuous immersion and resistant to asphalt products.
- B. Type II: Applications not exposed to sunlight, butyl rubber based.
- C. Exterior Wall Sealants at perimeters of new penetrations, exposed to sunlight: Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
- D. Backer Rods: ASTM C 1330, Type B (bicellular material with a surface skin).

2.5 SCHEDULE OF FASTENERS

- A. Exposed fasteners: Shall be stainless steel with stainless steel bonded neoprene or EPDM washers.
- B. Fasteners shall be compatible to all materials to which they come in contact.
- C. Cleat, Counter-flashing, and Surface Fastened Components.
 - 1. Wood Substrate: No. 10 stainless steel wood screws with stainless steel bonded neoprene washers of length necessary to penetrate wood substrate one inch.
 - 2. Metal Substrate: Minimum No. 10 stainless steel sheet metal screws or as necessary to suit application with stainless steel bonded neoprene washers.

2.6 FABRICATION

- A. Form sections to match existing profiles, true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest practical lengths.
- C. Hem exposed edges of metal 1/2-inch; miter and seam corners.
- D. Fasten and seal metal joints.
- E. All fabrication and installation of sheet metal shall be in accordance with the latest published SMACNA and NRCA guidelines and recognized roofing and sheet metal industry standards.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating work.
- B. Apply bituminous protective backing on surfaces in contact with dissimilar materials.
- C. Tie-ins or contact with dissimilar metals: Install separation layer of elastomeric membrane between metal surfaces.

- D. Provide minimum protection requirements indicated in Section 075210 for all sheet metal materials and tools to be set on existing roof surfaces as part of the execution of the work in this Section. Failure to provide specified minimum protection measures may result in repairs to existing roofs at Contractor's expense.

3.3 INSTALLATION

- A. Provide flashings of materials indicated on Drawings at all junctures of the roof with perimeters, curbs, mechanical, electrical equipment, etc., that a completely watertight installation is achieved.
- B. Fabricate and install sheet metal work with lines, arises and angles sharp and true, and plane surfaces free from warps and buckles. Bead or return all exposed edges. Tin metal for full area of contact on soldered seams and joints. Do soldering slowly with well heated coppers, thoroughly heating seams and completely filling them with solder.
- C. Submit details not covered in Drawings for approval by Engineer.
- D. Lock all joints in a watertight manner:
 - 1. Solder all sheet metal joints at counterflashings and square to round flashings.
 - 2. Pop rivet and seal all other joints, with pop rivets spaced at 4" o.c. maximum.
- E. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- F. Fasten sheet metal with approved fasteners at a minimum of 12 inches on centers unless otherwise specified in these Specifications or the Drawings.
- G. Do not proceed with installation of sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

3.4 CLEANING

- A. Remove bituminous markings from all exposed sheet metal.
- B. Remove all sheet metal debris and fasteners from the work area.

END OF SECTION

DIVISION 08 THROUGH 21

NOT USED

DIVISION 22

PLUMBING

SECTION 220000 - GENERAL REQUIREMENTS FOR PLUMBING WORK

PART 1 - GENERAL

1.1 SCOPE

- A. This project involves construction of a facility titled "RENOVATIONS AT O'HENRY MIDDLE SCHOOL" shown on the plans and described herein.

1.2 DRAWINGS

- A. Do not scale from the Drawings; contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements. Contractor shall determine exact locations from field measurements. Refer also to all architectural, structural, etc., drawings. The lack of specific detail of all offsets, transitions, etc., shall not relieve the Contractor of responsibility to provide such necessary elements to coordinate his work with building construction and with other trades.

1.3 BIDDING

- A. Section 00700, "General Conditions" Article 6.2.4 specifies requirements for Substitutes and "Approved Equal" Items. All bids must be based only on the equipment and materials as scheduled on the drawings and as specified, or on equivalent equipment and materials. Any Contractor who assumes equivalence of products and who bases his bid on that assumption does so at his own risk. A listing of approved alternative manufacturers does not mean that all products of a particular alternative manufacturer are acceptable alternatives to the scheduled items.

1.4 INTENT

- A. All equipment, materials and labor that may be necessary to complete work in accordance with the intent of these plans and specifications shall be furnished by the Contractor without additional cost.
- B. All systems represented in the documents shall, unless specifically noted to the contrary, be provided and installed complete with all necessary components to form a complete and functioning system. Submission of bids will be considered confirmation that complete and functional systems have been included in the bids.
- C. If any discrepancy or confusion is perceived in the documents, the Contractor shall call such to the attention of the Engineer for clarification of the documents prior to bidding or construction. If any inconsistencies or contradictions within the construction documents are discovered after the construction contracts are awarded, the Engineer and/or Engineer shall determine the intent and correct interpretation of the construction documents.
- D. Contractor shall supervise and direct the work competently and efficiently and in accordance with the drawings and specifications. Contractor shall be responsible for using construction

means, methods, techniques, sequences, and procedures as are compatible with the project's requirements and will result in a project completed in accordance with the requirements of the drawings and specifications.

1.5 CODES, PERMITS AND FEES

- A. Contractor shall comply with all local, state and national codes and shall pay for all applicable costs, fees and permits.

1.6 EXAMINATION OF SITE

- A. Each contractor submitting proposal(s) for this work shall examine the site and shall take into consideration conditions that may affect the work. No information given on the plans shall relieve the Contractor of this responsibility. Submission of a bid shall be considered as compliance with the site examination requirements.
- B. Contractor shall verify location, size, elevation, pressure, and any other pertinent data of existing utilities. Additional costs incurred due to a failure to verify such data and to coordinate associated work with respective utility providers shall not be the Owner's responsibility but shall be borne by Contractor.
- C. Excavate by hand and with caution to locate all utilities prior to machine excavation. Should any service be interrupted, Contractor shall repair it immediately and at no cost to the Owner.

1.7 CONNECTION TO UTILITIES

- A. All costs associated with providing utilities including, but not limited to, connection fees, boring under roads, etc., shall be included in the Contractor's bid price whether such costs are incurred by Contractor or charged by a utility company.
- B. Contractor shall arrange gas service in accordance with utility company regulations and shall pay all applicable fees and costs.

1.8 VIBRATION AND NOISE

- A. Each of the various pieces of equipment shall operate without objectionable vibration or noise. All rotating equipment shall be statically and dynamically balanced and shall be mounted, supported, and fastened so that vibration shall not exceed levels specified for the equipment item. The specific type of vibration isolation to be installed shall be submitted to the Engineer for his approval.
- B. If, in the opinion of the Engineer or Owner, objectionable vibration or noise or transmission thereof to the building occurs, the Contractor shall execute remedial measures as may be necessary to eliminate such unsatisfactory operating conditions. The work and material thereby required shall be furnished and performed at the Contractor's expense.

1.9 GUARANTEE

- A. Each Contractor shall guarantee all labor and materials furnished by him for a period of one year unless otherwise noted. Guarantee period shall extend from the time of final written acceptance of the installation or upon usage by a written directive from the Owner, whichever occurs first. The guarantee shall cover the repair or replacement, without additional cost to the Owner, of any defective material or faulty workmanship.
- B. Additional special guarantees may be specified in individual specification sections or on Drawings.

1.10 SERVICE

- A. Provide necessary service of each system, such as adjustment of controls, air distribution, and water balancing valves, mechanical repair of equipment, and other work requiring specialized training, at no cost to the Owner, for a period of one year, concurrent with the warranty period specified above.

1.11 SUBMITTALS

- A. Before orders are placed, contractor shall submit specific information on list of equipment and principal materials specified. Contractor shall indicate and/or provide names of manufacturers, catalog and model numbers, cut sheets, and such other supplementary information as necessary for evaluation. Refer to related section in Division 1, Section "Submittals." Each shall be submitted and shall include all items mentioned by model number and/or manufacturer's name in the specifications or on the drawings, including but not limited to the following:
 - 1. HVAC - All equipment, air devices, insulation, piping, valves, controls and other principal materials.
 - 2. Plumbing Equipment – Water heaters, pumps, tanks, and valves.
- B. Requirements - Each submittal shall:
 - 1. Bear a stamp or specific written indication that Contractor has reviewed and approved all submittals prior to submission to Engineer,
 - 2. Be clearly marked as to which specific piece of equipment is being submitted, by use of a permanent marker, stamp, etc., so as to distinguish it from other pieces of equipment that may occur on the same page,
 - 3. Be clearly marked as to which available options are being submitted that are associated with a piece of equipment, and
 - 4. Be complete with respect to quantities, dimensions, specific performance, materials, and similar data to enable Engineer to review the proposed equipment.
 - 5. Omission by Contractor of any of the above requirements for submittals will subject submittal to automatic rejection without review.
 - 6. Any submittals received by Engineer that were not requested shall be returned without review of any kind.
 - 7. Include all product data as required to confirm submitted products and those related thereto (e.g. adhesives, sealants, paints, coatings, etc.) comply with VOC threshold requirements per AISD Sustainability Scorecard ALL 3MA.

C. Substitutions

1. By submitting substitute equipment, contractor is affirming that it will fit, connect and function properly, and be maintainable for the function intended and in the space available. The Contractor's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but completely.
2. The Contractor shall be responsible for the cost of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete; that is, it shall include the costs effect on any and all other trades.
3. The Engineer may require shop drawings of mechanical rooms or systems of the substituted equipment.

1.12 SAFETY

- A. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work, and Contractor shall comply with all laws governing safety, specifically the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", state and federal.

1.13 COORDINATION

- A. Each Contractor's bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Failure on the part of the Contractor to coordinate with all other trades resulting in interference shall be sufficient reason to require the Contractor to replace or rebuild the work involved at no extra charge.

1.14 STORAGE OF MATERIALS

- A. Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be rain-proof and lockable as required. Materials or equipment stored on site but not in a lockable, rain-proof storage facility shall be stored above ground or above slab. Contractor shall take necessary precautions to prevent entry of and/or damage from dirt, trash, water, or vermin. Equipment not properly stored and protected shall be, at the discretion of the Engineer, replaced at no cost to Owner. Roofs are not acceptable storage areas unless specifically allowed in writing by the Engineer.

1.15 LABELING

- A. Each device for which an independent testing authority has established a standard shall have affixed a label indicating its compliance and listing. Such independent testing authorities shall include, but not be limited to, the following:
 1. A.D.C. Air Diffusion Council
 2. A.G.A. American Gas Association
 3. A.M.C.A. Air Movement and Control Association
 4. A.N.S.I. American National Standards Institute
 5. A.R.I. Air-Conditioning and Refrigeration Institute

6. A.S.H.R.A.E. American Society of Heating, Refrigerating, and Air-Conditioning Engineers
7. A.S.M.E. American Society of Mechanical Engineers
8. A.S.P.E. American Society of Plumbing Engineers
9. A.S.S.E. American Society of Sanitary Engineers
10. A.S.T.M. American Society for Testing and Materials
11. A.W.W.A. American Water Works Association
12. C.T.I. Cooling Tower Institute
13. F.M. Factory Mutual
14. I.A.P.M.O. International Association of Plumbing and Mechanical Officials
15. M.S.S. Manufacturers Standardization Society of the Valve and Fittings Industry
16. N.A.P.H.C.C. National Association of Plumbing, Heating, Cooling Contractors
17. N.B.S. National Bureau of Standards
18. N.E.B.B. National Environmental Balancing Bureau
19. N.F.P.A. National Fire Protection Association
20. P.D.I. Plumbing and Drainage Institute
21. S.B.C.C.I. Southern Building Code Congress International
22. S.M.A.C.N.A. Sheet Metal and Air Conditioning Contractors' National Association
23. T.I.M.A. Thermal Insulation Manufacturers Association
24. U.L. Underwriters Laboratory

1.16 SITE VISIT REPORTS

- A. During the course of the job, the Engineer's Office Project Manager will observe work in progress and will subsequently prepare a written site visit report which will be sent for distribution to the owner and to whomever else the Engineer desires.

1.17 CUTTING, PATCHING, AND PENETRATIONS

- A. No joists, beams, girders, columns, slabs, or other structural elements shall be cut, drilled, or altered in any way by the Contractor without first obtaining written permission and instructions from the Engineer.
- B. Where cutting any non-structural element(s) of walls, floors or ceilings is necessary to permit the installation of any work under this contract, or to repair any defects that may appear up to the expiration of the guarantee, such cutting shall be done by Contractor with as little damage as reasonably possible to the element being cut, to adjacent elements, or to the work of other trades.
- C. After the necessary work has been completed, the damage shall be repaired by the Contractor, who shall pay all costs of such cutting and patching. All patching or sealing of cuts, penetrations, etc., including final appearance of same, shall be done to the approval of the Engineer.
- D. Where a penetration or cutting of a ceiling, wall, or other building membrane is required or made, each such penetration or cut shall be made neatly with a cutting tool such as a saw, sharp knife, etc., and not with an impact tool such as a hammer, screwdriver, wrench, crowbar, etc. Each such penetration or cut shall be no larger than reasonably necessary, and penetrations in

occupied or publicly accessible spaces shall have a chrome-plated escutcheon installed large enough to cover the entire opening.

1.18 FIRESTOPPING

- A. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

1.19 HOUSEKEEPING PADS

- A. Contractor shall construct housekeeping pads for floor-mounted mechanical and electrical equipment including, but not limited to, the following:
 - 1. Air handling units, storage tanks and water heaters, boilers, pumps, chemical feeders.
- B. Pads shall be made 3½ - 6 inches thick (reference plans), of concrete with reinforcing such as welded wire screen, and with beveled edges. Contractor shall paint each pad with a masonry conditioner such as Sherwin-Williams A5V2 and then with a gray (or other color at Owner's request) industrial enamel such as Sherwin-Williams B-54 series.

1.20 OPERATING TESTS

- A. General
 - 1. After all mechanical and electrical systems have been completed and put into operation, Contractor shall subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation. All associated costs of such tests, including labor, fuel, apparatuses, piping, etc., shall be borne by the Contractor.
 - 2. Contractor shall make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. The Contractor shall return to the project during the first year and in the opposite season from which the system was initially operated and shall check the proper operation of the mechanical and electrical systems. Contractor shall perform any adjustments or corrective procedures required for the proper operation of all systems.
- B. Notification
 - 1. Contractor shall give the Engineer seven days prior notification of any test so that the Engineer will have time to be present if he/she so desires.
- C. Reports
 - 1. After each test is performed, the Contractor who performed the test shall prepare and issue a report to include the following information:
 - 2. Project name and location, date of the report,
 - 3. Contractor's name, address, and telephone number; if the Contractor performing the test is a Subcontractor, indicate also for whom the test is being performed, their name, address, telephone number, and a contact person's name,
 - 4. the date, or range of dates, of the test,

5. the name of the Contractor's employee who was responsible for performing or for overseeing the performing of the test,
6. a brief description of the system being tested,
7. a brief description of the testing procedure,
8. a summary of the test result(s),
9. a brief assertion that the system was tested as stated and that the system complied with the requirements of the contract documents or those of the Authority Having Jurisdiction, whichever is the most stringent, and
10. a hand-written date and signature of someone who has authority or responsibility from the company that performed test(s), and a hand-written brief note stating that the above information is true and accurate.
11. If the tested system is tested in parts, then one report may be made after the last part is tested.
12. The report shall be issued to the Engineer within five working days after the test is completed.
13. Such reports shall be required of all mechanical or electrical systems which require tests for pressure, water tightness, flow, resistance, or conductivity.
14. Services of a Manufacturer's Representative
15. For all major systems or equipment required by subsequent specifications sections to have tests or inspections by a manufacturer's representative, the manufacturer's representative shall prepare a written report to be sent to the Engineer for subsequent distribution to the Engineer, Owner, General Contractor, and to whomever else the Engineer deems necessary. The report shall include at least the following:
 - a. Date of the visit, name and title of the representative, name and location of the project
 - b. Name and title of any observers
 - c. A brief description of the equipment being inspected and / or tested
 - d. A brief discussion of the quality of the installation including any important items (in the manufacturer's experience) that were done correctly, as well as any items that were done incorrectly or not to recommendations
 - e. A list of test and / or inspections performed and the results of same
 - f. A brief statement of whether the installation conforms to manufacturer's recommendations and/or requirements, and if not what is required to bring the installation into conformance

D. Deficiencies and Defects

1. Contractor shall be responsible for providing all labor and materials, at no cost to anyone except Contractor, to correct any deficiencies or defects reported by manufacturer's representative.
2. If, in the opinion of the manufacturer's representative, the deficiencies and defects are sufficiently serious, then Contractor shall arrange for, and bear all costs of, another inspection by manufacturer's representative after corrective work is complete.
3. The above process shall continue until the manufacturer's representative approves the installation.

1.21 TEMPORARY FACILITIES

- A. Jobsite office facilities: Refer to Architect's documents.

- B. Temporary storage facilities: Refer to Architect's documents.
- C. Sanitary facilities for workmen: Refer to Architect's documents.
- D. Temporary utilities: Refer to Architect's documents.
 - 1. The Contractor shall pay the cost of all water, gas, and electricity used during construction.
 - 2. Each contractor will pay for his portion of the works required permits, meter taps and any other charge by the City. The temporary and/or permanent meters will be entered in the Contractor's name for payment until the facilities are accepted by the Owner.
 - 3. Temporary Water Service:
 - a. The Plumbing Contractor shall install a permanent water supply line from the nearest water main to the project, and shall maintain and protect it until completion of the project and acceptance by the Owner.
 - b. The Plumbing Contractor shall provide, protect and maintain a adequate water supply for the use of all contractors on the project, for construction purposes, either by means of the permanent water supply line or by installing a temporary water line. This water supply shall be made available within fifteen (15) days after written request has been made to the Plumbing Contractor by the contractor requiring it, with copies of the request being submitted to all interested parties, including the Engineer.
 - c. The Plumbing Contractor shall install a meter and a temporary water line to a point approximately ten (10) feet from the building. The exact point to which the water line is installed shall be indicated by the General Contractor. From this point, each contractor shall install, valve, maintain and protect such water supply lines that he might need to execute the work of his contract.
 - 4. Temporary heat:
 - a. Heating required after enclosure of the building shall be classified as "temporary heat". The building shall be considered enclosed when the roof and walls are weatherproof, and windows, doors and other openings are closed sufficiently to provide reasonable heat retention.
 - b. The Mechanical Contractor shall provide temporary heat, and shall furnish, at his own expense, such labor and supervision as is necessary for efficient, safe operation until acceptance of the Project by the Owner.
 - c. A minimum temperature of 60 degrees F and maximum of 80 degrees F shall be maintained in the building during and after installation of any materials or finishes that are affected by temperature or humidity. More strenuous requirements may apply to specific products or processes.
 - d. At all times after the building is enclosed, the temperature in all interior parts of the building shall be kept above freezing.
- E. Operation of equipment:
 - 1. When heating, air conditioning, ventilating, exhaust or other items of electrical or other equipment are installed, it shall be the responsibility of the contractor installing such equipment to operate it for a satisfactory period of time, as required by the Engineer for proper testing of the equipment and for proper instruction of the Owner's operating personnel.

2. All other items of equipment, testing meters, testing instruments and incidentals required for proper testing of the equipment and for proper instructing of the Owner's operating personnel, shall be provided by the contractor providing and installing the equipment.
- F. When any temporary facility is no longer needed for the proper conduct of the work, as determined by the Engineer, the Owner or the contractor who installed such temporary facilities, the contractor shall completely remove it from the project and shall repair or replace any material, equipment and finished surface damaged in installation, use or removal of the temporary facility.

PART 2 - PRODUCTS AND WORKMANSHIP

2.1 MATERIALS

- A. All materials shall be new and of the quality specified. Materials shall be free from defects. Where manufacturers' names are mentioned in these specifications or on the plans, it has been done in order to establish a standard of quality and construction.
- B. Contractor will be responsible for transportation of his materials to and on the job and will be responsible for the storage and protection of his materials and work until the final acceptance of the job. At the end of each work day, each Contractor is responsible for covering or protecting his work or materials that may be susceptible to damage even if such damage is the result of unforeseen causes, e.g. an overnight thunderstorm. Failure to do so will be sufficient cause for rejection of any item in question, and any such item shall be replaced at Contractor's expense.
- C. Contractor shall verify that all pieces of equipment will fit through available openings in building and that all equipment can be installed without modification of building structure.
- D. All adhesives, sealants, paints, and coatings used shall comply with VOC threshold requirements per AISD Sustainability Scorecard ALL 3Ma.

2.2 WORKMANSHIP

- A. The workmanship shall, in all respects, be of the highest grade, and all construction shall be done according to the best practices of the trade. Piping, ducting and conduit shall be concealed unless otherwise noted, and installed square to the building lines. Any work not meeting this requirement shall be replaced or rebuilt without extra expense to the Owner.

2.3 ROOF PENETRATIONS, EQUIPMENT AND PIPING SUPPORTS

- A. Roof supports for equipment, piping, conduits, ductwork, etc. shall be provided and installed by an Owner approved Roofing Contractor and shall be provided under this Contract. The Mechanical, Electrical, and Plumbing Contractor shall coordinate and communicate closely with the Roofing Contractor as to locations of supports, sizes and weights of devices or equipment being supported, etc.

2.4 ACCESSIBILITY

- A. Access Panels - Access panels shall be provided wherever necessary for possible future replacement, adjustment, or maintenance of operating devices such as machinery, valves, dampers, switches, relays, etc., or to other critical non-operating devices such as pull boxes, inspection parts, gauges, etc. Such access panels shall be provided and installed by Contractor, whether or not shown on drawings, and shall be brought to the attention of Engineer for his approval of type, color, etc. Where access is provided in rated members, the access panels shall be of a type that maintains the integrity of the member penetrated.
- B. Access to Equipment
 - 1. All pipes, tubing, conduit, etc., including, but not limited to, domestic cold water and hot water piping, waste and vent piping, drain piping of any type, electrical conduit, wiring not in conduit, and pneumatic control tubing shall be installed in such a way so as not to prevent and/or not to make unreasonably difficult the removal, operation, use, or maintenance of equipment, access panels or doors, pathways (especially in attics or crawl spaces), observation ports, measurement or balancing devices, junction boxes, etc..
 - 2. If access for these purposes is prevented or made unreasonably difficult in the opinion of the Engineer, then the Contractor shall make modifications or repairs at no cost to anyone except the Contractor. Such modifications or repairs shall be considered neither complete nor adequate until the Engineer is satisfied that access for the above purposes is achieved.

PART 3 - RECORDS AND SERVICES FOR THE OWNER

3.1 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall prepare and provide three copies of operating and maintenance manuals. Contractor shall deliver these four bound sets to the Engineer for approval. Each manual shall be in a ring binder and shall be indexed with dividers for each section. Delivery of required documents is a condition of final acceptance.
- B. Each manual shall contain at least the following:
 - 1. Certificates of acceptance from inspecting authorities,
 - 2. Waiver of all liens,
 - 3. For each piece of equipment:
 - a. Operating and safety instructions, service manuals, and parts lists applicable to each item of equipment furnished (Contractor shall clearly distinguish in the manual between information that pertains to the particular equipment and information which does not.)
 - b. Nameplate data and design parameters for equipment
 - c. Name, phone number, and address of vendor, manufacturer's representative, and warrantee provider,
 - 4. Both paper copies and electronic files in format specified and approved by the Owner shall be provided for the following:
 - a. All shop drawings and as-built drawings.
 - b. All approved submittals.

- c. Operating and safety instructions, service manuals, and parts lists applicable to each item of equipment furnished (Contractor shall clearly distinguish in the manual between information that pertains to the particular equipment and information which does not.),
5. Names, phone numbers and addresses of all subcontractors, vendors, manufacturer's representatives, and warrantee providers,
6. Acceptance letter from each Contractor with blanks for date of acceptance and date of expiration of warranties and guarantees.

3.2 INSTRUCTIONS FOR OWNER

- A. Contractor shall instruct the Owner's operating personnel in the operation and maintenance of all mechanical equipment. Contractor shall furnish any special servicing tools required for maintenance.
- B. Provide training as specified in each Section and/or on the Drawings. Training arrangements must be coordinated with, and approved by, the Owner.

3.3 DEMONSTRATION

- A. Contractor shall conduct a demonstration of the installation upon completion of the work. Prior to this, all work shall have been completed, tested, balanced, and placed in operation. Qualified persons must be present at demonstration to operate all systems and prove the performance of the equipment. The schedule for this demonstration shall be coordinated with the Engineer.

END OF SECTION 220000

SECTION 22 01 00
COMMISSIONING OF PLUMBING 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 Plumbing systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section 019113- “GENERAL COMMISSIONING REQUIREMENTS” for general commissioning process requirements.
 - 2. Division 23 Section 230100 – “COMMISSIONING OF MECHANICAL SYSTEMS”.
 - 3. 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, CxA will conduct third-party commissioning activities to verify installation and performance of systems.
- B. Refer to section 019113- GENERAL COMMISSIONING REQUIREMENTS for additional definitions and assignment of responsibilities.

1.4 CONTRACTOR’S COMMISSIONING RESPONSIBILITIES

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Prepare submittals
- C. Review pre-functional/installation checklists prepared by CxA for plumbing system components.
- D. Complete pre-functional/installation checklists prepared by CxA.

- E. Provide competent technical personnel, tools, equipment, and manpower to assist CxA during field-verification of pre-functional checklists completed by Contractor.
- F. Provide competent technical personnel, tools, equipment, and manpower to assist CxA during functional testing of plumbing systems and equipment.
- G. Correct deficiencies identified by CxA in Commissioning Log, as directed by Design Team.
- H. Accompany CxA during verification of corrective action.
- I. Provide training.
- J. Provide O&M and As-built documentation
- K. Provide test data, inspection reports, and certificates.

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 pre-functional/installation checklists and manufacturer's pre-start and startup checklists for plumbing systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certification that installation, pre-start checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for pre-functional third-party verification by CxA.
 - 6. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for functional third-party testing by CxA.
 - 7. Test and inspection reports and certificates.
 - 8. Corrective action documents.

1.6 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.
- C. Plumbing equipment submittals and installation manuals.
- D. Plumbing shop and coordination drawings required for Commissioning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to section 019113 - 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-22 items.
- B. Refer to Section 019113 - 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.
- C. Do not proceed with system start-up or functional testing until after CxA has conducted third-party verification of pre-functional checklists.

3.3 SYSTEM START-UP

- 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.

3.4 FUNCTIONAL TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that plumbing 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 any required testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- 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 required.

3.5 GENERAL FUNCTIONAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of plumbing testing shall include entire plumbing installation. 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. The CxA may direct that set points be altered when simulating conditions is not practical.
- F. 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.
- G. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- H. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.6 GENERAL TESTING PROCEDURES FOR PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT

- A. Pipe system cleaning, flushing, hydrostatic test and chemical treatment requirements are specified in Division 22 piping Sections. Plumbing Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- B. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of energy systems and equipment at the direction of the CxA. The CxA shall

determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

- C. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hydronic and other distribution plumbing systems.

3.7 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED

A. General

- 1. The following paragraphs outline the functional test procedures for the various Div. 22 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 GC has certified that systems are ready for functional testing.

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. Domestic Water Heaters

- 1. Verify accuracy of temperature sensors and thermometers.
- 2. Verify operation of hot water heater control thermostats and thermometer.
- 3. Verify water pressure within appropriate pressure range.
- 4. Verify system cycles and ramps up/down to maintain DHW temperature setpoint.
- 5. Witness manufacturer startup.

D. Domestic Water System

- 1. Verify operation of all interior plumbing fixtures (water closets and urinals flush, all faucets work, no leaks are present, etc.)
- 2. Verify lack of water hammer, and water hammer arrestors are installed where called for.
- 3. Verify operation of trap primers.
- 4. Verify temperature control of thermostatic mixing valves, and that hot water is present at all hot water outlets, at desired temperature.
- 5. Verify correct piping and operation of domestic hot water circulating pumps.

E. Pumps

- 1. Verify operation of domestic hot water circulation pump.
- 2. Verify On/Off controls for domestic hot water circulation pump.
- 3. Verify operation of elevator sump pump.
- 4. Verify elevator sump pump controls and alarms.

- F. Other Plumbing Systems: Testing requirements for additional plumbing systems shall be identified by CxA prior to beginning of construction.

3.8 TRAINING

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS.

3.9 O&M MANUALS

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS and section 017800 CLOSEOUT SUBMITTALS.

END OF SECTION 22 01 00

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Comply with fire resistive penetration seal requirements, if applicable.
- B. Steel Pipe Sleeves: Schedule 20 to 40, galvanized if either end is in damp location.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 3. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
- C. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces, except where extension beyond surface is needed for selected fire sealing method.
 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Seal penetrations in exterior building envelope fully against water, insect and vermin intrusion.
 2. As detailed on Drawings.
- B. Interior Partitions:
1. Piping Smaller than NPS 6 (DN 150): If not otherwise detailed on Drawings, steel pipe sleeves, except as required for fire rated penetrations.
- C. Exterior Walls:
1. Piping Smaller than NPS 6 (DN 150): If not otherwise detailed on Drawings or required for fire rating, galvanized steel pipe sleeves.
 2. For penetrations below grade, provide water-resistant compression seals with stainless steel bolts. Use "Link Seal" or approved equal.
- D. Roofs:
1. Any penetration through the roof shall be coordinated with the Architect and the Owner's roofing advisor to ensure that it is water-proof, visually acceptable, and structurally sound.
 2. Piping and Wiring Groups: For two or more penetrants in one area, unless otherwise detailed on the drawings, provide a sheetmetal entry cover of essentially gooseneck form, flashed into the roof or set on a roof curb. The outer end of the gooseneck shall face no greater than 45 degrees from straight down. Provide a pair of overlapping custom-cut split escutcheon plates at the outer end, and seal water tight around each penetrant. Provide fiberglass insulation inside assembly at the plane of the roof insulation and secured in place.

3. Piping Smaller than NPS 6 (DN 150): If not otherwise detailed on Drawings or required for roof warranty or fire rating, steel pipe sleeves extending 4" above roof surface. Install UV-resistant elastomeric boot over top of sleeve, constricted and sealed to penetrating item.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 ESCUTCHEONS

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

1.5 FLOOR PLATES

- A. Split-Casting Floor Plates: Cast brass with concealed hinge.

1.6 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - EXECUTION

2.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - 2. Escutcheons for Existing Piping:
 - a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Existing Piping: Split-casting, floor-plate type.

END OF SECTION 220518

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Bronze swing check valves.
5. Bronze gate valves.
6. Bronze globe valves.

B. Related Sections:

1. Division 22 water distribution piping Sections for general-duty and specialty valves for site construction piping.
2. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
3. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 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. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, lead-free bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

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. American Valve, Inc.
 - b. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, lead free bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded, sweat, or press as applicable for the application.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded, sweat, or press as applicable for the application.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.4 IRON BUTTERFLY VALVES

A. 200 CWP, Iron Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

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. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Metraflex
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange, or grooved as applicable for the piping application.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Metrflex
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Vertical flow (up or down).
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Stem, Spring, Disc Holder, Seat Screw: Stainless Steel
 - f. Ends: Threaded, sweat, or press as applicable for the application..
 - g. Disc: Bronze or PTFE.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Metraflex
2. Description:
 - a. Standard: MSS SP-80, Type 3 or 4.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal or vertical upward flow. To 15° below horizontal.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded, sweat, or press as applicable for the application.
 - f. Disc: Bronze or PTFE.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.

- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

- 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. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet. Lead Free
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.8 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

- 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. Anvil International, Inc.
 - b. Metraflex, Inc.
 - c. Milwaukee Valve Company.
 - d. Mueller Steam Specialty; a division of SPX Corporation.

- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer.
- e. Seat: Bronze.

2.9 CHAINWHEELS

A. 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:

- 1. Babbitt Steam Specialty Co.
- 2. Roto Hammer Industries.
- 3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

- 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
- 2. Attachment: For connection to valve stems.
- 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
- 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball (full port) or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc for horizontal or upward flow direction. Center guided spring type for downward flow.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron center-guided check valves.
 - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves with end connections suitable for the application. Reference applicable piping specification sections for joint type requirements.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Angle Valves: Class 125 , bronze disc.
 - 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 125 , bronze disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 2. Iron, Center-Guided Check Valves: Class 125, compact-wafer , metal seat.

3.6 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Ball Valves: Three piece, full port, brass or bronze with brass, bronze or stainless-steel trim.
 - 2. Bronze Swing Check Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
 - 1. Iron Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 2. Iron Swing Check Valves: Class 125, metal seats.
 - 3. Iron Gate Valves: Class 125.
 - 4. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

- B. Related Sections:

1. Division 07 Section "Roof Accessories" for roof mounted pipe stands and equipment supports.
2. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

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.
- B. Wind-Restraint Loading: Equipment attachment points, supports and anchors shall be suitable for the following wind conditions, where exposed to wind loading:
 1. Basic Wind Speed: 90 MPH.
 2. Occupancy Classification: II.
 3. Exposure Condition C.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Metal framing systems.
 - 2. Pipe stands.
 - 3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 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.

2.2 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
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 inturred 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, Outdoors: Hot-dipped galvanized.
8. Metallic Coating, Indoors: Electroplated zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: N/A, refer to Roof Accessories section for all roof mounted pipe supports/stands.
- C. Low-Type, Single-Pipe Stand: N/A, refer to Roof Accessories section for all roof mounted pipe supports/stands.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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 (34.5-MPa), 28-day compressive strength.
- C. All sealants shall comply with AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal 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 the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: N/A, refer to Roof Accessories section for all roof mounted pipe supports/stands.
- F. Install hangers and supports complete with necessary attachments, 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 (DN 65) and larger and at changes in direction of piping.
- K. Load Distribution: Install hangers and supports so that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
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 allowed by 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.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

- b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for piping 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1/2 inch (13 mm). Provide cap nuts or other suitable protection over ends of rods where likely to be contacted by people.

3.5 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 a minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Conform to hanger and support details on drawings, where applicable.
- 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 carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. 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 (DN 15 to DN 750).
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 5. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 6. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- I. 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 24 (DN 24 to DN 600).
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

- J. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- K. 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. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. 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 (340 kg).
- L. 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.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.5 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 EXISTING STYLES

- A. Where suitable existing labeling and marking systems are already established, provide new labels and marking consistent with the existing systems. Conform to existing color, pattern, material, attachment, text size and other features except as necessary to conform to any code requirement or request from the Owner to use the new features specified below instead of existing features.
- B. Equipment and piping system labeling patterns, numbering, and other serial labeling shall be rational extensions of the Owner's established patterns, and be approved by Owner prior to creation.

2.2 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch ((1.6 mm)) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially or fully cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches ((38 mm) high).

2.6 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch

(19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd or acrylic enamel, black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1 (unless owner has another established color coding system), on each piping system.
 1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.

- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 30 feet (9 m) along each run. Reduce intervals to 15 feet (4.5 m) in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 – PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Domestic chilled-water piping for drinking fountains.
 - 5. Sanitary waste piping exposed to freezing conditions.
 - 6. Storm-water piping exposed to freezing conditions.
 - 7. Roof drains and rainwater leaders.
 - 8. Supplies and drains for handicap-accessible lavatories and sinks.
- C. Related Sections:
 - 1. Division 23 Section "HVAC Equipment Insulation."
 - 2. Division 23 Section "Duct Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Environmental Submittals, Product Data: For adhesives and sealants, documentation including printed statement of VOC content. Comply with AISD Sustainability Scorecard ALL 3MA Requirements.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 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.

1.5 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.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds. **Insulation used in this project shall have no formaldehyde binders.**
- 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 Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- 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 III with factory-applied ASJ or FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. Ramco Insulation, Inc.; Super-Stik.

- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES (AISD Sustainability VOC requirements supersede any herein. Ref 018113)

- 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. All adhesives shall comply with requirements below AND AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.

- d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS (AISD Sustainability VOC requirements supersede any herein. Ref 018113)

2.5

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 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 the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.6 SEALANTS (AISD Sustainability VOC requirements supersede any herein. Ref 018113)

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
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 (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
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 (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 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. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing, or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper, or 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, or 2.5-mil- (0.063-mm-) thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper or 2.5-mil- (0.063-mm-) thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. Polyguard Products, Inc.; Alumaguard 60.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 488 AWF.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, or 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system.
- 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.
- 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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 (100 mm) 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.

3.4 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 (50 mm) 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 (50 mm).
 - 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 Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Provide section of special insulation to comply with fire resistance rating, if required.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 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. Install removable insulation covers at locations indicated. Installation shall conform to the following:

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. 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 (50 mm) 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- 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 Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges 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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 - 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.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch (13 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.
 - 2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - 2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be one of the following:

- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2" thick.
 - C. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
- 3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE
- A. Refrigerant Suction Piping:
 - 1. All Pipe Sizes: Insulation shall be Elastomeric Foam: 1.5 inches (50 mm) thick.
- 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - B. If more than one material is listed, selection from materials listed is Contractor's option.
 - C. Elbows and fittings:
 - 1. Fitted PVC fitting covers, 20 mil. For cold piping, provide vapor seal using field-applied FSK or ASJ or other approved method prior to final covering.
 - D. Exposed Elastomeric Insulation: Apply PVC jacket or ASJ over UV-protective paint-on coating.
- 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - B. If more than one material is listed, selection from materials listed is Contractor's option.
 - C. Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.
 - D. Elastomeric Insulation: Apply Self-Adhesive Outdoor Jacket over UV-protective paint-on coating.

END OF SECTION 220719

SECTION 221112 - WATER DISTRIBUTION PIPING

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 water distribution piping from locations indicated to fixtures and equipment inside building.
- B. Related Sections include the following:
 - 1. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.

1.3 DEFINITIONS

- A. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping.
- B. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.
- C. The following are industry abbreviations for plastic piping materials:
 - 1. CPVC: Chlorinated polyvinyl chloride.
 - 2. NP: Nylon.
 - 3. PB: Polybutylene.
 - 4. PE: Polyethylene.
 - 5. PP: Polypropylene.
 - 6. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Combined Fire-Protection and Domestic, Service Entrance Piping: 250 psig (1725 kPa).
 - 2. Service Entrance Piping: 160 psig (1100 kPa).
 - 3. Water Distribution Piping: 125 psig (860 kPa).

1.5 SUBMITTALS

- A. Water Samples, Test Results, and Reports: Specified in "Field Quality Control" and "Cleaning" articles.

1.6 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
- C. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

2.2 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.
- C. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.
- D. Where indicated in Piping Applications article and not otherwise prohibited on the drawings, Joints may also be Viega Pro-Press or Nibco PresSystem joining method with a non-toxic synthetic rubber elastomer seal (EPDM O-RINGS) in the fitting socket. The fitting shall be pressed under substantial pressure by power tool forming a joint rated for 200 psi and tested for 600 psi, approved by IAPMO IGC 137-99/PS 117-2000 & ANSI/NSF 61. Fitting material shall conform to ANSI/ASM B16.22 & B16.18, approved by Uniform Plumbing Code.

2.3 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- C. Brazing Filler Metal: AWS A5.8, BCuP, copper phosphorus or BAg, silver classification.
- D. Copper, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- E. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 VALVES

- A. Refer to Division 220523 Section "General Duty Valves for Plumbing Piping" for general-duty valves.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, as required if acceptable by AHJ.
- C. Underground, Service Entrance Piping: Do not use flanges or valves underground. Use the following:
 - 1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.
 - 2. 2-Inch NPS (DN50) and Larger: Soft copper tube, Type L (Type B); copper, solder-joint pressure fittings; and soldered joints.
 - 1. 2-1/2- to 3-1/2-Inch NPS (DN65 to DN90): Hard copper tube, Type L (Type B) or Type K (Type A); copper, solder-joint fittings; and soldered joints.

- D. Aboveground, Water Distribution Piping: Use the following:
2. 2-Inch NPS (DN50) and smaller: Hard copper tube, Type L (Type B) or Type K (Type A); copper, solder-joint fittings; and soldered joints.
 1. 2-1/2- to 3-1/2-Inch NPS (DN65 to DN90): Hard copper tube, Type L (Type B) or Type K (Type A);; copper, solder-joint fittings; and soldered joints.
 3. 4- to 6-Inch NPS (DN100 to DN150): Hard copper tube, Type L (Type B) or Type K (Type A); with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
 4. 8-Inch NPS (DN200): Hard copper tube, Type L (Type B) or Type K (Type A); with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
- E. Underground, Water Distribution Piping: Do not use flanges or valves underground. Use the following:
1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type L (Type B) or Type K (Type A);; wrought-copper, solder-joint pressure fittings; and soldered joints.
 2. 2-Inch NPS (DN50) and Smaller: Hard copper tube, Type L (Type B) or or Type K (Type A);; wrought-copper, solder-joint pressure fittings; and soldered joints.
 3. 2-1/2- to 4-Inch NPS (DN65 to DN100): Hard copper tube, Type L (Type B) or or Type K (Type A); wrought-copper, solder-joint pressure fittings; and soldered joints.
- F. Non-Potable-Water Piping: Use the following:
1. 3-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B) or Type K (Type A);; solder-joint pressure fittings; and soldered joints.
 2. 2- to 3-Inch NPS (DN50 to DN80): Hard copper tube, Type L (Type B) with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
 3. 4- to 6-Inch NPS (DN100 to DN150): Hard copper tube, Type L (Type B) or Type K (Type A); with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
 4. 8-Inch NPS (DN200): Hard copper tube, Type L (Type B) or Type K (Type A); with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use gate, ball, or butterfly valves.
 2. Throttling Duty: Use globe, ball, or butterfly valves.
- B. Grooved-end butterfly valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION, GENERAL

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

3.5 SERVICE ENTRANCE PIPING INSTALLATION (N/A THIS PROJECT)

- A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building. Refer to Division 2 Section "Water Systems" for water service piping.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each service entrance pipe.
- C. Install water-pressure regulators (if any) downstream from shutoff valves. Refer to Division 15 Section "Plumbing Specialties" for water-pressure regulators.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping" for sleeves and sleeve seals.

3.6 WATER DISTRIBUTION PIPING INSTALLATION

- A. Install piping with 0.25 percent slope downward toward drain.

3.7 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.8 VALVE INSTALLATION

- A. Sectional Valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated. Use gate or ball valves for piping 2-inch NPS (DN50) and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS (DN65) and larger.
- B. Shutoff Valves: Install shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated. Use gate or ball valves for piping 2-inch NPS (DN50) and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS (DN65) and larger.
- C. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
- D. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Use ball valve for piping 2-inch NPS (DN50) and smaller and butterfly valve for piping 2-1/2-inch NPS (DN65) and larger. Refer to Division 15 Section "Plumbing Specialties" for balancing valves.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
 - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet (30 m) and less.
- B. Install supports according to Division 22 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

MAX. PIPE SIZE	MAX. HORIZ. SPACING	MIN. ROD DIAMETER	MAX. VERT. SPACING
3/4" (DN20)	60" (1500 mm)	3/8" (10 mm)	10' (3 m)
1" (DN25)	72" (1800 mm)	3/8" (10 mm)	10' (3 m)
1-1/4" (DN32)	72" (1800 mm)	3/8" (10 mm)	10' (3 m)
2" (DN50)	96" (2400 mm)	1/2" (13 mm)	10' (3 m)
2-1/2" (DN65)	108" (2700 mm)	1/2" (13 mm)	10' (3 m)
3" (DN80)	10' (3 m)	1/2" (13 mm)	10' (3 m)
3-1/2" (DN90)	10' (3 m)	1/2" (13 mm)	10' (3 m)
5" (DN125)	10' (3 m)	1/2" (13 mm)	10' (3 m)
6" (DN150)	10' (3 m)	5/8" (16 mm)	10' (3 m)
8" (DN200)	10' (3 m)	3/4" (19 mm)	10' (3 m)

- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

- A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
- B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:
 - 1. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
 - 3. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.

3.11 FIELD QUALITY CONTROL

- A. Inspect water distribution piping as follows:
- B. Inspect service entrance piping and water distribution piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Test water distribution piping as follows:
- D. Test service entrance piping and water distribution piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.12 CLEANING

- A. Clean and disinfect service entrance piping and water distribution piping as follows:
 - 1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

- b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for 3 hours.
 - c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.13 TESTING AND ADJUSTING

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.
 - 1. Water-Pressure Regulators: Set outlet pressure at 80 psig (550 kPa) maximum, unless otherwise indicated.
 - 2. Recirculation Balancing Valves: Adjust to specified flow rate, or if not specified, to rate that results in approximately 5°F temperature drop from source to farthest fixture during zero-use conditions.
- E. Energize pumps and verify proper operation.

END OF SECTION 221112

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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. Strainers.
 - 2. Water-hammer arresters.
 - 3. Flexible connectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product scheduled on drawings or specified hereinafter.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 SCHEDULES ON DRAWINGS

- A. Refer to schedules on drawings for items specified in this section. Nothing in this section shall be interpreted as reducing scheduled requirements. Additional and more rigorous requirements herein supplement the requirements in the schedules.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
 2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and bronze for NPS 2-1/2 (DN 65) and larger.
 3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
 4. Screen: Stainless steel with round perforations unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm).
 6. Drain: ball valve and hose threads

2.5 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum [200 psig (1380 kPa)] [250 psig (1725 kPa)].
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa)
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap

device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each control valve, water temperature regulating valve and pump.
- E. Install water-hammer arresters in water piping according to PDI-WH 201.
- F. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.

- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping and tubing joining materials.
 - 3. Valves.
 - 4. Appendix: Utility (Texas Gas Service) form for contractor completion and request of new medium pressure service.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, 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.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
 - 2. Minimum Operating Pressure of Service Meter: 5 psig (34.5 kPa).
- B. Natural-Gas System Pressure within Buildings: 5 psig (3.45 kPa) or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Steel Support 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.
- 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. 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.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating and protect from direct sunlight.

1.9 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

1.11 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 3. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 MANUAL GAS SHUTOFF VALVES

- A. See Aboveground Manual Gas Shutoff Valve Schedule" article for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig (862 kPa).
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
 1. CWP Rating: 125 psig (862 kPa).
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 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. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.

5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. PRESSURE REGULATORS

- F. Description: Single stage and suitable for natural gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.
1. NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
 2. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 3. Line Pressure Regulators: ANSI Z21.80 with 5-psig- (34.5-kPa-) minimum inlet pressure rating.
- G. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but

not less than 3 inches (75 mm) long and same size as connected pipe.
Install with space below bottom of drip to remove plug or cap.

- N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- P. Connect branch piping from top or side of horizontal piping.
- Q. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
 - 1. Do not use natural-gas piping ahead of the meter as a grounding electrode. Do bond natural gas piping downstream of the meter to the grounding electrode system.
- R. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" AND Division 07 Section "Roof Accessories."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
 5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

3.6 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.8 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
 - a. Paint new ferrous piping and ferrous valve bodies with factory-applied paint or protective coating.
 - 2. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Topcoat: Exterior alkyd enamel (semigloss).
 - c. Color: YELLOW.
- B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to the Uniform Plumbing Code Chapter 12 and authorities having jurisdiction.
 - 2. Disconnect any appliances rated for less than the required test pressure prior to testing.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.10 PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
(3.45 KPA, 14" WG)

- A. NPS 2 and Smaller: Branch piping shall be the following:
 - 1. Steel pipe with steel welded fittings and welded joints.
 - a. Wrap half-lapped with corrosion-protection tape listed for the purpose where underground and to 6" above grade.
- B. NPS 2-1/2 and Larger: Branch piping shall be the following:
 - 1. Steel pipe with steel welded fittings and welded joints.
 - a. Wrap half-lapped with corrosion-protection tape listed for the purpose where underground and to 6" above grade.

3.11 PIPING SCHEDULE FOR SYSTEM PRESSURES GREATER THAN 0.5
PSIG (3.45 KPA)

- A. NPS 2 and Smaller: Branch piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and welded joints.
 - a. Wrap half-lapped with corrosion-protection tape listed for the purpose where underground and to 6" above grade.
- B. NPS 2-1/2 and Larger: Branch piping shall be the following:
 - 1. Steel pipe with steel welded fittings and welded joints.
 - a. Wrap half-lapped with corrosion-protection tape listed for the purpose where underground and to 6" above grade.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Distribution piping valves shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Valves in branch piping for single appliance shall be the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- C. All valves shall maintain their listed shutoff rating at the applicable service pressure as indicated on the plans.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 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. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Cast-Iron, Hubless-Piping Couplings:
 - 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. MG Piping Products Company.
 - 2. Standard: ASTM C 1277.
 - 3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. 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:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. 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:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. 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.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation where applicable.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Horizontal Sanitary Drainage Piping: Downward in direction of flow at 2 percent (1/4"/Ft) for piping NPS 2.5 (DN 60) and smaller; 1 percent (1/8"/Ft) for NPS 4 to NPS 6, and 1/2% (1/16"/Ft) for NPS 8 (DN 200) and larger piping.
 2. Vent Piping: Down toward vertical fixture vent or toward vent stack at 1/2% percent.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install aboveground PVC piping according to ASTM D 2665.
- O. Install underground PVC piping according to ASTM D 2321.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
1. Provide cleanouts at locations and at intervals consistent with the plumbing code. For waste piping below floor, install wall cleanouts above floor or floor cleanouts; do not rely on any cleanouts below floor level in the crawl space.
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."
- 3.2 JOINT CONSTRUCTION
- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded, nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- C. Support vertical piping and tubing at base and at each floor.

- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 8 (DN 200) and smaller shall be any of the following, except as indicated on the Project Drawings:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 8 (DN 200) and smaller shall be any of the following, except as indicated on the Project Drawings:
 1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
 3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. Where not exposed to sunlight, solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. all vent piping less than 6" above the flood rim of fixtures served shall be run as waste piping with according material, routing, joint, and pitch to drain requirements.
- D. Underground, soil, waste, and vent piping NPS 12 (DN 300) and smaller shall be any of the following, except as indicated on the Project Drawings:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI cast-iron hubless-piping couplings; and coupled joints.
 3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION 221316

DIVISION 23

MECHANICAL

SECTION 230000 - GENERAL REQUIREMENTS FOR MECHANICAL WORK

PART 1 - GENERAL

1.1 SCOPE

- A. This project involves renovation of a facility titled "RENOVATIONS AT O'HENRY MIDDLE SCHOOL" as shown on the plans and described herein.

1.2 DRAWINGS

- A. Do not scale from the Drawings; contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements. Contractor shall determine exact locations from field measurements. Refer also to all architectural, structural, etc., drawings. The lack of specific detail of all offsets, transitions, etc., shall not relieve the Contractor of responsibility to provide such necessary elements to coordinate his work with building construction and with other trades.

1.3 BIDDING

- A. All bids must be based only on the equipment and materials as scheduled on the drawings and as specified or on equivalent equipment and materials from a pre approved alternative manufacturer. No bids may be based on a substitute or other alternative without specific written prior approval from the Engineer. Any Contractor who assumes equivalence of products and who bases his bid on that assumption does so at his own risk.
- B. A listing of approved alternative manufacturers does not mean that all products of a particular alternative manufacturer are acceptable alternatives to the scheduled items; it merely means that for bidding prior approval is not required. All fixtures and devices must still be submitted according to the prescribed procedures. In addition, some items that have an important visual affect, e.g. electric water coolers, may be required to receive Engineer's or Owner's approval also.

1.4 INTENT

- A. All equipment, materials and labor that may be necessary to complete work in accordance with the intent of these plans and specifications shall be furnished by the Contractor without additional cost.
- B. All systems represented in the documents shall, unless specifically noted to the contrary, be provided and installed complete with all necessary components to form a complete and functioning system. Submission of bids will be considered confirmation that complete and functional systems have been included in the bids.
- C. If any discrepancy or confusion is perceived in the documents, the Contractor shall call such to the attention of the Engineer for clarification of the documents prior to bidding or construction. If any inconsistencies or contradictions within the construction documents are discovered after

the construction contracts are awarded, the Engineer and/or Engineer shall determine the intent and correct interpretation of the construction documents.

- D. Contractor shall supervise and direct the work competently and efficiently and in accordance with the drawings and specifications. Contractor shall be responsible for using construction means, methods, techniques, sequences, and procedures as are compatible with the project's requirements and will result in a project completed in accordance with the requirements of the drawings and specifications.

1.5 CODES, PERMITS AND FEES

- A. Contractor shall comply with all local, state and national codes and shall pay for all applicable costs, fees and permits.

1.6 EXAMINATION OF SITE

- A. Each contractor submitting proposal(s) for this work shall examine the site and shall take into consideration conditions that may affect the work. No information given on the plans shall relieve the Contractor of this responsibility. Submission of a bid shall be considered as compliance with the site examination requirements.
- B. Contractor shall verify location, size, elevation, pressure, and any other pertinent data of existing utilities. Additional costs incurred due to a failure to verify such data and to coordinate associated work with respective utility providers shall not be the Owner's responsibility but shall be borne by Contractor.
- C. Excavate by hand and with caution to locate all utilities prior to machine excavation. Should any service be interrupted, Contractor shall repair it immediately and at no cost to the Owner.

1.7 CONNECTION TO UTILITIES

- A. All costs associated with providing utilities including, but not limited to, connection fees, boring under roads, etc., shall be included in the Contractor's bid price whether such costs are incurred by Contractor or charged by a utility company.

1.8 VIBRATION AND NOISE

- A. Each of the various pieces of equipment shall operate without objectionable vibration or noise. All rotating equipment shall be statically and dynamically balanced and shall be mounted, supported, and fastened so that vibration shall not exceed levels specified for the equipment item. The specific type of vibration isolation to be installed shall be submitted to the Engineer for his approval.
- B. If, in the opinion of the Engineer or Owner, objectionable vibration or noise or transmission thereof to the building occurs, the Contractor shall execute remedial measures as may be necessary to eliminate such unsatisfactory operating conditions. The work and material thereby required shall be furnished and performed at the Contractor's expense.

1.9 GUARANTEE

1.10 Each Contractor shall guarantee all labor and materials furnished by him for a period of one year unless otherwise noted. Guarantee period shall extend from the time of final written acceptance of the installation or upon usage by a written directive from the Owner, whichever occurs first. The guarantee shall cover the repair or replacement, without additional cost to the Owner, of any defective material or faulty workmanship.

1.11 SERVICE

- A. All necessary service of each system, such as adjustment of controls, air distribution, and water balancing valves, mechanical repair of equipment, and other work requiring specialized training, shall be furnished by the Contractor, at no cost to the Owner, for a period of one year, concurrent with the warranty period specified above.

1.12 SUBMITTALS

- A. Before orders are placed, contractor shall submit specific information on list of equipment and principal materials specified. Contractor shall indicate and/or provide names of manufacturers, catalog and model numbers, cut sheets, and such other supplementary information as necessary for evaluation. Refer to related section in Division 1, Section "Submittals." Each shall be submitted and shall include all items mentioned by model number and/or manufacturer's name in the specifications or on the drawings, including but not limited to the following:

1. HVAC - All equipment, air devices, insulation, piping, valves, controls and other principal materials.

- B. Requirements - Each submittal shall:

1. Bear a stamp or specific written indication that Contractor has reviewed and approved all submittals prior to submission to Engineer,
2. Be clearly marked as to which specific piece of equipment is being submitted, by use of a permanent marker, stamp, etc., so as to distinguish it from other pieces of equipment that may occur on the same page,
3. Be clearly marked as to which available options are being submitted that are associated with a piece of equipment, and
4. Be complete with respect to quantities, dimensions, specific performance, materials, and similar data to enable Engineer to review the proposed equipment.
5. Omission by Contractor of any of the above requirements for submittals will subject submittal to automatic rejection without review.
6. Any submittals received by Engineer that were not requested shall be returned without review of any kind.
7. Include all product data as required to confirm submitted products and those related thereto (e.g. adhesives, sealants, paints, coatings, etc.) comply with VOC threshold requirements per AISD Sustainability Scorecard ALL 3MA.

- C. Substitutions

1. No substitution is allowable without Engineer's written approval ten days prior to bid due date unless the manufacturer is listed on the Drawings or in the specifications as being a

pre approved alternative manufacturer. Any submittal received without such written approval or prior approval is subject to unqualified rejection.

2. Contractor's responsibility shall be to verify that submitted substitute equipment will fit in the space available. The Contractor's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but completely.
3. The Contractor shall be responsible for the cost of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete, that is, it shall include the costs affect on any and all other trades.
4. The Engineer may request shop drawings of mechanical rooms or systems of the substituted equipment.

1.13 SAFETY

- A. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work, and Contractor shall comply with all laws governing safety, specifically the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", state and federal.

1.14 COORDINATION

- A. Each Contractor's bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Failure on the part of the Contractor to coordinate with all other trades resulting in interference shall be sufficient reason to require the Contractor to replace or rebuild the work involved at no extra charge.

1.15 STORAGE OF MATERIALS

- A. Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be rain-proof and lockable as required. Materials or equipment stored on site but not in a lockable, rain-proof storage facility shall be stored above ground or above slab. Contractor shall take necessary precautions to prevent entry of and/or damage from dirt, trash, water, or vermin. Equipment not properly stored and protected shall be, at the discretion of the Engineer, replaced at no cost to Owner. Roofs are not acceptable storage areas unless specifically allowed in writing by the Engineer.

1.16 LABELING

- A. Each device for which an independent testing authority has established a standard shall have affixed a label indicating its compliance and listing. Such independent testing authorities shall include, but not be limited to, the following:
 1. A.D.C. Air Diffusion Council
 2. A.G.A. American Gas Association
 3. A.M.C.A. Air Movement and Control Association
 4. A.N.S.I. American National Standards Institute
 5. A.R.I. Air-Conditioning and Refrigeration Institute
 6. A.S.H.R.A.E. American Society of Heating, Refrigerating, and Air-Conditioning Engineers

7. A.S.M.E. American Society of Mechanical Engineers
8. A.S.P.E. American Society of Plumbing Engineers
9. A.S.S.E. American Society of Sanitary Engineers
10. A.S.T.M. American Society for Testing and Materials
11. A.W.W.A. American Water Works Association
12. C.T.I. Cooling Tower Institute
13. F.M. Factory Mutual
14. I.A.P.M.O. International Association of Plumbing and Mechanical Officials
15. M.S.S. Manufacturers Standardization Society of the Valve and Fittings Industry
16. N.A.P.H.C.C. National Association of Plumbing, Heating, Cooling Contractors
17. N.B.S. National Bureau of Standards
18. N.E.B.B. National Environmental Balancing Bureau
19. N.F.P.A. National Fire Protection Association
20. P.D.I. Plumbing and Drainage Institute
21. S.B.C.C.I. Southern Building Code Congress International
22. S.M.A.C.N.A. Sheet Metal and Air Conditioning Contractors' National Association
23. T.I.M.A. Thermal Insulation Manufacturers Association
24. U.L. Underwriters Laboratory

1.17 SITE VISIT REPORTS

- A. During the course of the job, the Engineer's Office Project Manager will observe work in progress and will subsequently prepare a written site visit report which will be sent for distribution to the owner and to whomever else the Engineer desires.

1.18 CUTTING, PATCHING, AND PENETRATIONS

- A. No joists, beams, girders, columns, slabs, or other structural elements shall be cut, drilled, or altered in any way by the Contractor without first obtaining written permission and instructions from the Engineer.
- B. Where cutting any non-structural element(s) of walls, floors or ceilings is necessary to permit the installation of any work under this contract, or to repair any defects that may appear up to the expiration of the guarantee, such cutting shall be done by Contractor with as little damage as reasonably possible to the element being cut, to adjacent elements, or to the work of other trades.
- C. After the necessary work has been completed, the damage shall be repaired by the Contractor, who shall pay all costs of such cutting and patching. All patching or sealing of cuts, penetrations, etc., including final appearance of same, shall be done to the approval of the Engineer.
- D. Where a penetration or cutting of a ceiling, wall, or other building membrane is required or made, each such penetration or cut shall be made neatly with a cutting tool such as a saw, sharp knife, etc., and not with an impact tool such as a hammer, screwdriver, wrench, crowbar, etc. Each such penetration or cut shall be no larger than reasonably necessary, and penetrations in occupied or publicly accessible spaces shall have a chrome-plated escutcheon installed large enough to cover the entire opening.

1.19 FIRESTOPPING

- A. Where a penetration is made in a fire-rated building assembly (wall, floor, ceiling, floor-ceiling, roof-ceiling, etc.) or in a membrane of a fire-rated assembly, install an appropriate firestopping assembly. Submit proposed assembly to design team for approval before application.

1.20 HOUSEKEEPING PADS

- A. Contractor shall construct housekeeping pads for floor-mounted mechanical and electrical equipment including, but not limited to, the following:
 - 1. Air handling units
 - 2. Boilers
 - 3. Pumps
 - 4. Chemical feeders.
- B. Pads shall be made 3½ - 6 inches thick (reference plans), of concrete with reinforcing such as welded wire screen, and with beveled edges. Contractor shall paint each pad with a masonry conditioner such as Sherwin-Williams A5V2 and then with a gray (or other color at Owner's request) industrial enamel such as Sherwin-Williams B-54 series.

1.21 OPERATING TESTS

- A. General
 - 1. After all mechanical and electrical systems have been completed and put into operation, Contractor shall subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation. All associated costs of such tests, including labor, fuel, apparatuses, piping, etc., shall be borne by the Contractor.
 - 2. Contractor shall make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. The Contractor shall return to the project during the first year and in the opposite season from which the system was initially operated and shall check the proper operation of the mechanical and electrical systems. Contractor shall perform any adjustments or corrective procedures required for the proper operation of all systems.
- B. Notification
 - 1. Contractor shall give the Engineer seven days prior notification of any test so that the Engineer will have time to be present if he/she so desires.
- C. Reports
 - 1. After each test is performed, the Contractor who performed the test shall prepare and issue a report to include the following information:
 - 2. Project name and location, date of the report,
 - 3. Contractor's name, address, and telephone number; if the Contractor performing the test is a Subcontractor, indicate also for whom the test is being performed, their name, address, telephone number, and a contact person's name,
 - 4. the date, or range of dates, of the test,

5. the name of the Contractor's employee who was responsible for performing or for overseeing the performing of the test,
6. a brief description of the system being tested,
7. a brief description of the testing procedure,
8. a summary of the test result(s),
9. a brief assertion that the system was tested as stated and that the system complied with the requirements of the contract documents or those of the Authority Having Jurisdiction, whichever is the most stringent, and
10. a hand-written date and signature of someone who has authority or responsibility from the company that performed test(s), and a hand-written brief note stating that the above information is true and accurate.
11. If the tested system is tested in parts, then one report may be made after the last part is tested.
12. The report shall be issued to the Engineer within five working days after the test is completed.
13. Such reports shall be required of all mechanical or electrical systems which require tests for pressure, water tightness, flow, resistance, or conductivity.
14. Services of a Manufacturer's Representative
15. For all major systems or equipment required by subsequent specifications sections to have tests or inspections by a manufacturer's representative, the manufacturer's representative shall prepare a written report to be sent to the Engineer for subsequent distribution to the Engineer, Owner, General Contractor, and to whomever else the Engineer deems necessary. The report shall include at least the following:
 - a. Date of the visit, name and title of the representative, name and location of the project
 - b. Name and title of any observers
 - c. A brief description of the equipment being inspected and / or tested
 - d. A brief discussion of the quality of the installation including any important items (in the manufacturer's experience) that were done correctly, as well as any items that were done incorrectly or not to recommendations
 - e. A list of test and / or inspections performed and the results of same
 - f. A brief statement of whether the installation conforms to manufacturer's recommendations and/or requirements, and if not what is required to bring the installation into conformance

D. Deficiencies and Defects

1. Contractor shall be responsible for providing all labor and materials, at no cost to anyone except Contractor, to correct any deficiencies or defects reported by manufacturer's representative.
2. If, in the opinion of the manufacturer's representative, the deficiencies and defects are sufficiently serious, then Contractor shall arrange for, and bear all costs of, another inspection by manufacturer's representative after corrective work is complete.
3. The above process shall continue until the manufacturer's representative approves the installation.

1.22 TEMPORARY FACILITIES

- A. Jobsite office facilities: Refer to Division 01 documents.

- B. Temporary storage facilities: Refer to Division 01 documents.
- C. Sanitary facilities for workmen: Refer to Division 01 documents.
- D. Temporary utilities: Refer to Division 01 documents.
 - 1. The Owner will pay the cost of all water, gas, and electricity used during construction.
 - 2. Each contractor will pay for his portion of the work's required permits, meter taps and any other charges by the City or Utilities.
- E. Operation of equipment:
 - 1. When heating, air conditioning, ventilating, exhaust or other items of electrical or other equipment are installed, it shall be the responsibility of the contractor installing such equipment to operate it for a satisfactory period of time, as required by the Engineer for proper testing of the equipment and for proper instruction of the Owner's operating personnel.
 - 2. All other items of equipment, testing meters, testing instruments and incidentals required for proper testing of the equipment and for proper instructing of the Owner's operating personnel, shall be provided by the contractor providing and installing the equipment.
- F. When any temporary facility is no longer needed for the proper conduct of the work, as determined by the Engineer, the Owner or the contractor who installed such temporary facilities, the contractor shall completely remove it from the project and shall repair or replace any material, equipment and finished surface damaged in installation, use or removal of the temporary facility.

PART 2 - PRODUCTS AND WORKMANSHIP

2.1 MATERIALS

- A. All materials shall be new and of the quality specified. Materials shall be free from defects. Where manufacturers' names are mentioned in these specifications or on the plans, it has been done in order to establish a standard of quality and construction.
- B. Contractor will be responsible for transportation of his materials to and on the job, and will be responsible for the storage and protection of his materials and work until the final acceptance of the job. At the end of each work day, each Contractor is responsible for covering or protecting his work or materials that may be susceptible to damage even if such damage is the result of unforeseen causes, e.g. an overnight thunderstorm. Failure to do so will be sufficient cause for rejection of any item in question, and any such item shall be replaced at Contractor's expense.
- C. Contractor shall verify that all pieces of equipment will fit through available openings in building and that all equipment can be installed without modification of building structure.

2.2 WORKMANSHIP

- A. The workmanship shall, in all respects, be of the highest grade, and all construction shall be done according to the best practices of the trade. Piping, ducting and conduit shall be concealed

unless otherwise noted, and installed square to the building lines. Any work not meeting this requirement shall be replaced or rebuilt without extra expense to the Owner.

2.3 ROOF PENETRATIONS, EQUIPMENT AND PIPING SUPPORTS

- A. Roof supports for equipment, piping, conduits, ductwork, etc. shall be provided and installed by an Owner approved Roofing Contractor and shall be provided under this Contract. The Mechanical, Electrical, and Plumbing Contractor shall coordinate and communicate closely with the Roofing Contractor as to locations of supports, sizes and weights of devices or equipment being supported, etc.

2.4 ACCESSIBILITY

- A. Access Panels - Access panels shall be provided wherever necessary for possible future replacement, adjustment, or maintenance of operating devices such as machinery, valves, dampers, switches, relays, etc., or to other critical non-operating devices such as pull boxes, inspection parts, gauges, etc. Such access panels shall be provided and installed by Contractor, whether or not shown on drawings, and shall be brought to the attention of Engineer for his approval of type, color, etc.. Where access is provided in rated members, the access panels shall be of a type that maintains the integrity of the member penetrated.
- B. Access to Equipment
 - 1. All pipes, tubing, conduit, etc., including, but not limited to, domestic cold water and hot water piping, waste and vent piping, drain piping of any type, electrical conduit, wiring not in conduit, and pneumatic control tubing shall be installed in such a way so as not to prevent and/or not to make unreasonably difficult the removal, operation, use, or maintenance of equipment, access panels or doors, pathways (especially in attics or crawl spaces), observation ports, measurement or balancing devices, junction boxes, etc..
 - 2. If access for these purposes is prevented or made unreasonably difficult in the opinion of the Engineer, then the Contractor shall make modifications or repairs at no cost to anyone except the Contractor. Such modifications or repairs shall be considered neither complete nor adequate until the Engineer is satisfied that access for the above purposes is achieved.

PART 3 - RECORDS AND SERVICES FOR THE OWNER

3.1 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall prepare and provide three copies of operating and maintenance manuals. Contractor shall deliver these four bound sets to the Engineer for approval. Each manual shall be in a ring binder and shall be indexed with dividers for each section. Delivery of required documents is a condition of final acceptance.
- B. Each manual shall contain at least the following:
 - 1. Certificates of acceptance from inspecting authorities,
 - 2. Waiver of all liens,
 - 3. For each piece of equipment:

- a. operating and safety instructions, service manuals, and parts lists applicable to each item of equipment furnished (Contractor shall clearly distinguish in the manual between information that pertains to the particular equipment and information which does not.),
 - b. nameplate data and design parameters for equipment,
 - c. name, phone number, and address of vendor, manufacturer's representative, and warrantee provider,
4. Copies of all shop drawings and as-built drawings (as-built drawings shall be on a reproducible vellum as produced by a Xerox or photographic process),
 5. Copies of all approved submittals,
 6. Mechanical system warranties, which begin on date of beneficial occupancy:
 - a. This project incorporates systems which must be completed in sequential order. Certain systems must be completed for use by the Contractor, without Owner having beneficial use of these systems.
 - b. Substantial completion and acceptance of each system by the Owner, signifies the system is acceptable, without further inspection. Custody of these systems remains with the Contractor.
 - c. Beneficial occupancy will occur when the systems are integrated and the Owner is receiving the benefit of these systems. The Owner assumes custody of the systems and the Warranty period begins.
 - d. The manufacturers' Warranty of equipment shall be noted with the start dates, coinciding with the beneficial occupancy date, and the end dates coinciding with the Manufacturers' warranty period.
 - e. All equipment warranty start dates shall be submitted in writing to the owner and the engineer for their approval.
 7. Names, phone numbers and addresses of all subcontractors, vendors, manufacturer's representatives, and warrantee providers,
 8. Acceptance letter from each Contractor with blanks for date of acceptance and date of expiration of warranties and guarantees.

3.2 INSTRUCTIONS FOR OWNER

- A. Contractor shall instruct the Owner's operating personnel in the operation and maintenance of all mechanical equipment. Contractor shall furnish any special servicing tools required for maintenance.

3.3 DEMONSTRATION

- 3.4 Contractor shall conduct a demonstration of the installation upon completion of the work. Prior to this, all work shall have been completed, tested, balanced, and placed in operation. Qualified persons must be present at demonstration to operate all systems and prove the performance of the equipment. The schedule for this demonstration shall be coordinated with the Engineer.

END OF SECTION 230000

SECTION 23 01 00**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 and Plumbing) systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section 019113 – “GENERAL COMMISSIONING REQUIREMENTS” for general commissioning process requirements.
 - 2. Division 22 Section 220100 - “COMMISSIONING OF PLUMBING SYSTEMS”.
 - 3. Division 23 Section 230926c – “COMMISSIONING OF BUILDING AUTOMATION SYSTEM (LON)”.
 - 4. 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, CxA will conduct third-party commissioning activities to verify installation and performance of systems.
- B. Refer to section 019113- 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 COMMISSIONING RESPONSIBILITIES

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Prepare submittals
- C. Review pre-functional/installation checklists prepared by CxA for mechanical system components.
- D. Complete pre-functional/installation checklists prepared by CxA.
- E. Provide competent technical personnel, tools, equipment, and manpower to assist CxA during field-verification of pre-functional checklists completed by Contractor.
- F. Provide competent technical personnel, tools, equipment, and manpower to assist CxA during functional testing of mechanical systems and equipment.
- G. Correct deficiencies identified by CxA in Commissioning Log, as directed by Design Team.
- H. Accompany CxA during verification of corrective action.
- I. Provide training.
- J. Provide O&M and As-built documentation
- K. Provide test data, inspection reports, and certificates.

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 pre-functional/installation checklists and manufacturer's pre-start and startup checklists for mechanical systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certification 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 pre-functional third-party verification by CxA.
 - 6. Certificate of readiness certifying that mechanical systems, subsystems, equipment, and associated controls are ready for functional third-party testing by CxA.
 - 7. Test and inspection reports and certificates.
 - 8. Corrective action documents.

1.7 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.
- C. Mechanical equipment submittals and installation manuals.
- D. Mechanical shop and coordination drawings required for the Commissioning process.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to section 019113 - 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. Refer to Section 019133 - 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.
- C. Do not proceed with system start-up or functional testing until after CxA has conducted third-party verification of pre-functional checklists.

3.3 SYSTEM START-UP

- 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.

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, and corrective work approved.
- 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. Provide technicians, instrumentation, and tools to verify testing and balancing of mechanical systems at the direction of the CxA.
 - 1. 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.

3.6 GENERAL FUNCTIONAL 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 with CxA. Point-to-point check out sheets and as-built control diagrams shall be provided to CxA so he may develop testing procedures.
- 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 Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air distribution systems; special exhaust; and other distribution systems, including HVAC terminal equipment and unitary equipment.

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.
 - 3. Functional testing of HVAC systems shall include testing of the Building Automation System. Refer to Section 23 09 26c Commissioning of Building Automation System.
- 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. Cooling Towers:

1. Record outside air temperature during test.
2. Record programmed setpoints (condenser water temp, OA reset temps, heater temp, freeze control temp, low-limit temp.)
3. Record programmed schedules
4. Verify fans run smoothly and quietly.
5. Verify voltages and amperages are within tolerance.
6. Verify correct fan rotation (in VFD Auto, Hand, Manual, and Bypass positions).
7. Verify tower data in TA&B report versus design
8. Verify fan modulation to maintain temperature setpoint.
9. Verify condenser water bypass valve operation
10. Verify all alarms and safeties.
11. Verify all interlocks.
12. Verify all sequences.

D. Chillers:

1. Record outside air temperature during test.
2. Record programmed setpoints (supply chilled water setpoint, minimal temperature differentials, minimal flow, safeties)
3. Verify chillers run smoothly and quietly under varying loads.
4. Verify voltages and amperages are within tolerance.
5. Verify chiller data in TA&B report versus design (condenser and evaporator side)
6. Verify compressor modulation to control supply chilled water temperature.
7. Verify low-flow (condenser and evaporator) shutdown and restart.
8. Verify high-condenser water alarm and shutdown
9. Verify loss of power restart
10. Verify all alarms and safeties.
11. Verify all interlocks
12. Verify all sequences.

E. HVAC Pumps:

1. Record outside air temperature during test.
2. Record programmed schedules
3. Verify pumps run smoothly and quietly.
4. Verify voltages and amperages are within tolerance.
5. Verify correct fan rotation (in VFD Auto, Hand, Manual, and Bypass positions).
6. Verify pump data in TA&B report versus design
7. Verify all alarms and safeties.
8. Verify all interlocks.
9. Verify all sequences.

F. VAV Boxes:

1. Record outside air temperature during test.
2. Record space temperature during test.
3. Record programmed setpoints (occ/unocc heating and cooling temps, max and min airflows, discharge air temp, safeties)
4. Record programmed schedules
5. Verify voltages and amperages are within tolerance.
6. Verify VAV data in TA&B report versus design
7. Verify fan operation.
8. Verify hot water control valve operation.
9. Verify damper operation
10. Verify all alarms and safeties.
11. Verify all interlocks.
12. Verify all sequences.

G. Boilers:

1. Record outside air temperature during test.
2. Record programmed schedules.
3. Record programmed setpoints (hot water supply, safeties).
4. Verify boiler fan runs smoothly and quietly.
5. Verify voltages and amperages are within tolerance.
6. Verify gas pressure is within tolerance.
7. Verify burner modulation/staging at varying loads
8. Verify flow data in TA&B report versus design
9. Verify all alarms and safeties.
10. Verify all interlocks.
11. Verify all sequences.

H. Air Handling Units:

1. Record outside air temperature during test.
2. Record programmed setpoints (occ/unocc heating and cooling temps, coil discharge air temps, static pressure, economizer temp, CO2 setpoint, safeties and alarms)
3. Record programmed schedules
4. Verify fans run smoothly and quietly.
5. Verify voltages and amperages are within tolerance.
6. Verify correct fan rotation (in VFD Auto, Hand, Manual, and Bypass positions).
7. Verify AHU data in TA&B report versus design.
8. Verify chilled water control valve modulation to control supply air temperature.
9. Verify hot water control valve modulation to control discharge air temperature
10. Verify fan modulation to maintain duct static pressure setpoint.
11. Verify damper operation (Return, Outside and relief).
12. Verify Smoke detector operation.
13. Verify all alarms and safeties.
14. Verify all sequences.

I. Exhaust Fans

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.

J. Dx Single-Zone Units:

1. Record outside air temperature during test.
2. Record space temperature during test.
3. Record programmed setpoints (occ/unocc heating and cooling temps, runtime, safeties and alarms)
4. Record programmed schedules and interlocks
5. Verify fans run smoothly and quietly.
6. Verify voltages and amperages are within tolerance.
7. Verify unit data in TA&B report versus design.
8. Verify compressor cycling to control space temperature.
9. Verify Smoke detector operation.
10. Verify all alarms and safeties.
11. Verify all sequences.

K. 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.

L. Building Automation System –Refer to Section 23 09 26c

3.9 TRAINING

- A. Refer to section 019113- GENERAL COMMISSIONING REQUIREMENTS.

3.10 O&M MANUALS

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS and section 017800 CLOSEOUT SUBMITTALS.

END OF SECTION 23 01 00

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Comply with fire resistive penetration seal requirements, if applicable.
- B. Steel Pipe Sleeves: Schedule 20 to 40, galvanized if either end is in damp location.
- C. PVC Pipe Sleeves: Schedule 40 PVC; sunlight (UV) resistant where exposed.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - 3. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
- C. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces, except where extension beyond surface is needed for selected fire sealing method.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- D. Install PVC sleeves for fuel gas piping that passes under or through impervious cover such as concrete or asphalt paving. Provide vents and drains for sleeves as required by local code and as indicated on the drawings.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 23 Section "General Requirements for Mechanical Work."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Seal penetrations in exterior building envelope fully against water, insect and vermin intrusion.
 - a. As detailed on Drawings.
 - 2. Interior Partitions:
 - a. Piping Smaller than NPS 6 (DN 150): If not otherwise detailed on Drawings, steel pipe sleeves, except as required for fire rated penetrations.
 - 3. Exterior Walls:
 - a. Piping Smaller than NPS 6 (DN 150): If not otherwise detailed on Drawings or required for fire rating, galvanized steel pipe sleeves.
 - b. For penetrations below grade, provide water-resistant compression seals with stainless steel bolts. Use "Link Seal" or approved equal.
 - 4. Roofs:
 - a. Any penetration through the roof shall be coordinated with the Architect and the Owner's roofing advisor to ensure that it is water-proof, visually acceptable, and structurally sound.
 - b. Piping and Wiring Groups: For two or more penetrants in one area, unless otherwise detailed on the drawings, provide a sheetmetal entry cover of essentially

gooseneck form, flashed into the roof or set on a roof curb. The outer end of the gooseneck shall face no greater than 45 degrees from straight down. Provide a set of overlapping custom-cut split escutcheon plates at the outer end, and seal water tight around each penetrant. Provide fiberglass insulation inside assembly at the plane of the roof insulation and secured in place.

- c. Piping Smaller than NPS 6 (DN 150): If not otherwise detailed on Drawings or required for roof warranty or fire rating, steel pipe sleeves extending 4" above roof surface. Install UV-resistant elastomeric boot over top of sleeve, constricted and sealed to penetrating item.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 ESCUTCHEONS

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

1.5 FLOOR PLATES

- A. Split-Casting Floor Plates: Cast brass with concealed hinge.

1.6 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - EXECUTION

2.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
 - 2. Escutcheons for Existing Piping:
 - a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Existing Piping: Split-casting, floor-plate type.

END OF SECTION 230518

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Light-activated thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.
 - 6. Test plugs.
 - 7. Test-plug kits.
 - 8. Specialty Rough-ins

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 LIGHT-ACTIVATED THERMOMETERS

- A. Direct-Mounted, Light-Activated Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. REOTEMP Instrument Corporation.
 - c. Terice, H. O. Co.
 - d. Weiss Instruments, Inc.

- e. WIKA Instrument Corporation - USA.
 - f. Winters Instruments - U.S.
2. Case: Plastic or metal; 7-inch (178-mm) or 9-inch (229-mm) nominal size unless otherwise indicated.
 3. Scale(s): Deg F and deg C.
 4. Case Form: Adjustable angle.
 5. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 6. Stem: Aluminum, and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
 7. Display: Digital.
 8. Accuracy: Plus or minus 2 deg F (1 deg C).

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Thermowells:
 1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI.
 4. Material for Use with Steel Piping: CRES.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
 7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.

- e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi and kPa.
 8. Pointer: Dark-colored metal.
 9. Window: Glass or plastic.
 10. Ring: Brass or Stainless steel.
 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

- E. Minimum Pressure and Temperature Rating: 250 psig at 200 deg F (3450 kPa at 93 deg C).
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and/or EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following]**:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer (Air and chilled water systems): Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) Insert dimension diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).
- D. High-Range Thermometer (Heating water system): Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 FLOWMETERS

2.9 SPECIALTY ROUGH-INS

- A. Coordinate with suppliers of specialty equipment to provide ports, flanged spools, implants, etc. for installation of special equipment by others in pipes and ducts. Examples include, but are not limited to:
 - 1. Flow meters; turbine, venturi, or other types specified in Division 23 Section "Building Automation System."
- B. Install items in compliance with manufacturer's installation instructions, and in cooperation with the equipment specialist on the job to insure maximum accuracy, serviceability and performance.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches (51 mm) into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install flow indicators in piping systems in accessible positions for easy viewing.
- L. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- M. Install flowmeter elements in accessible positions in piping systems.
- N. Install permanent indicators on walls or brackets in accessible and readable positions.
- O. Install connection fittings in accessible locations for attachment to portable indicators.
- P. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic boiler.
 - 2. Inlet and outlet of each chiller.
- Q. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller, using a single gage with selection valves.
 - 3. Suction and discharge of each pump, using a single gage with selection valves.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Iron, single-flange butterfly valves.
 - 2. Iron, grooved-end butterfly valves.
 - 3. Bronze swing check valves.
 - 4. Iron center guided disc check valves.
 - 5. Bronze ball valves.
 - 6. Bronze gate valves.
 - 7. Iron gate valves.
 - 8. Specialty Valves
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. RS: Rising stem.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.7 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- B. Valve Sizes: Same as upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
1. Handwheel: For valves other than quarter-turn types.
 2. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.
- D. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions that allow operation of valves without breaking the vapor seal or disturbing insulation, and the following features:
1. Gate Valves: With rising stem.

2. Ball Valves: With protective sleeve of non-thermal-conductive material on operating handle.
3. Butterfly Valves: With extended neck.

E. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig (1035 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig (1035 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

C. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. Bray Controls; a division of Bray International.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
- e. Crane Co.; Crane Valve Group; Center Line.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Hammond Valve.
- i. Kitz Corporation.
- j. Milwaukee Valve Company.

- k. Mueller Steam Specialty; a division of SPX Corporation.
- l. NIBCO INC.
- m. Norriseal; a Dover Corporation company.
- n. Spence Strainers International; a division of CIRCOR International.
- o. Sure Flow Equipment Inc.
- p. Tyco Valves & Controls; a unit of Tyco Flow Control.
- q. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig (1035 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or -coated ductile iron.

2.3 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Kennedy Valve; a division of McWane, Inc.
- b. Shurjoint Piping Products.
- c. Tyco Fire Products LP; Grinnell Mechanical Products.
- d. Victaulic Company.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 175 psig (1200 kPa).
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.

- h. Powell Valves.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- k. Zy-Tech Global Industries, Inc.
- l. Metraflex

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

2.5 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Flomatic Corporation.
 - b. Metraflex, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer.
 - f. Seat: Bronze or stainless steel.
 - g. Trim: bronze or stainless steel.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Flomatic Corporation.
 - b. Metraflex, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
 - c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Globe, spring loaded.

- f. Ends: Flanged.
- g. Seat: Bronze or stainless steel.
- h. Trim: bronze or stainless steel

2.6 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.7 SPECIALTY VALVES

A. Manual Venturi Calibrated Balancing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IMI Flow Design;
 - b. Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Devices shall have a precision machined throat and have a stated catalog accuracy of 3% F.S.
3. The valve shall have differential readout ports fitted with self sealing seals to act as a check valve. The ports shall be provided with a protective cap.
4. Integral balancing and shutoff valve It shall have a memory stop to allow complete shut-off and return to set position without losing the set-point.

5. PUMP HEAD REQUIREMENT - The permanent pressure loss added to the pump head shall not exceed two feet, per device, at the design GPM in the wide-open position.
6. All devices shall have a Venturi section and a throttling valve with a memory stop on the downstream side of the venturi.
7. Material for the valve bodies shall be DZR brass or Ametal or steel and the venturi body will be brass or steel.
8. The ball valve (sizes 1/2" - 2") shall be Dezincification resistant brass (DZR) or bronze or Ametal body, blowout proof stem, virgin PTFE seats, brass stem, EPDM O-ring and teflon packed stem seals and steel handle. All ball valves shall conform to MSS-SP-110 standard or equal.
9. All butterfly valves 2" to 14", shall be ductile iron full-lug type, with EPDM seat, stainless steel stem, and stainless steel/bronze disc. All butterfly valves shall conform to MSS-SP-2002a and API 609, face to face dimensions for category A standards or equal.
10. Valves 1/2" to 2" shall be factory leak tested at 100 psi air under water
11. Minimum Ratings:
 - a. Devices with Sweat or NPT connections 1/2" - 2": 600 PSIG at 250°F
 - b. Devices with flanged connections 2" - 14": 240 PSIG at 250°F

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: ball or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 (DN 65) and Larger:
 - 1) Iron center guided disc check valve, wafer or globe type as space allows.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.
 - 3. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged or grooved ends.
 - 5. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged or grooved ends.
 - 6. For Grooved-End Steel Piping: Valve ends may be grooved.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Metal framing systems.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

- B. Related Sections:

1. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

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.

- B. Wind-Restraint Loading: Equipment attachment points, supports and anchors shall be suitable for the following wind conditions, where exposed to wind loading:

1. Basic Wind Speed: 90 MPH.
2. Occupancy Classification: II.
3. Exposure Condition C.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Metal framing systems.
 - 2. Pipe stands.
 - 3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 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.

2.2 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
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 inturred 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, Outdoors: Hot-dipped galvanized.
8. Metallic Coating, Indoors: Electroplated zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: N/A, refer to Roof Accessories section for all roof mounted pipe supports/stands.
- C. Low-Type, Single-Pipe Stand: N/A, refer to Roof Accessories section for all roof mounted pipe supports/stands.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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 (34.5-MPa), 28-day compressive strength.
- C. All sealants shall comply with AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal 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 the building structure.

- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: N/A, refer to Roof Accessories section for all roof mounted pipe supports/stands.
- F. Install hangers and supports complete with necessary attachments, 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 (DN 65) and larger and at changes in direction of piping.
- K. Load Distribution: Install hangers and supports so that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 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 allowed by 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.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for piping 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1/2 inch (13 mm). Provide cap nuts or other suitable protection over ends of rods where likely to be contacted by people.

3.5 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 a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Conform to hanger and support details on drawings, where applicable.
- 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 carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. 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 (DN 15 to DN 750).

2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 5. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 6. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- I. 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 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- J. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- K. 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. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. C-Clamps (MSS Type 23): For structural shapes.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. 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 (340 kg).
- L. 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.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Pipe riser resilient supports.

1.3 DEFINITIONS

- A. IBC: International Building Code.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 90 MPH.
 - 2. Occupancy Classification: II.
 - 3. Exposure Condition C.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

1.8 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern, and cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Provide sizes and thicknesses of elastomeric pads to satisfy recommended loadings and deflections for equipment with internal vibration isolation and balanced rotating parts. Select and size pads for maximum loading of 60 psi, minimum deflection of 0.1”.
- B. Utilize elastomeric or spring hangers where supporting piping connected to resiliently mounted equipment, or where hung from structure supporting rigidly mounted equipment above such as cooling towers. Travel range shall be no less than 150% of the equipment mount movement range.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.5 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 EXISTING STYLES

- A. Where suitable existing labeling and marking systems are already established, provide new labels and marking consistent with the existing systems. Conform to existing color, pattern, material, attachment, text size and other features except as necessary to conform to any code requirement or request from the Owner to use the new features specified below instead of existing features.
- B. Equipment and piping system labeling patterns, numbering, and other serial labeling shall be rational extensions of the Owner's established patterns, and be approved by Owner prior to creation.

2.2 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch ((1.6 mm)) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.

- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially or fully cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches ((38 mm) high).

2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch ((1.6 mm)) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and

proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches ((38 mm) high).

2.6 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, alkyd or acrylic enamel, black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible. Locate and size labels and lettering such that equipment tag is visible and legible from respective electrical disconnect.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting," or noted on the plans.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1 (unless owner has another established color coding system), on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 30 feet (9 m) along each run. Reduce intervals to 15 feet (4.5 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

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. **Testing, Adjusting, and Balancing (TAB) is NOT in contractor's scope of work.** TAB contractor will be under a separate contract between AISD's design engineer and TAB services provider. Contractor to allocate time for required facilitating TAB activities for the project.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Equipment Insulation."
 - 2. Division 23 Section "HVAC Piping Insulation."
 - 3. Division 23 Section "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Sustainability Submittals: For adhesives and sealants, documentation including printed statement of VOC content. Comply with AISD Sustainability Scorecard ALL 3MA Requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 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.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.9 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for 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. 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 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 the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- G. 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 ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide 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.

2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

- b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. All adhesives shall comply with requirements above AND AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 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 the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.
- D. All mastics shall comply with requirements above AND AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
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 (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. All sealants shall comply with requirements above AND AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

2.5 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.7 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.
 3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
 - 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. C & F Wire.

2.8 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. 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.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 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 (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. 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 (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for smoke- or fire-rated wall and partition penetrations. Externally insulate damper sleeves (unless pre-insulated) to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm). Comply with all damper installation instructions.
- E. Insulation Installation at Floor Penetrations:
1. Duct: 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 (50 mm).
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
- ### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION
- 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 not less than 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions, except that adhesive may be omitted from top surface of rectangular horizontal ducts.
 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 two times the insulation thickness, but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) 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 a least 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions, except that adhesive may be omitted from top surface of rectangular horizontal ducts.
 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 two times the insulation thickness, but not less than 3 inches (75 mm).
 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Indoor, concealed supply, return, and outdoor air.

2. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
3. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Outside-air and Supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density. FSK Jacket.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density. FSK Jacket.

B. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

C. Return-air duct and plenum insulation shall be one of the following:

1. Ducts: Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density. FSK Jacket.
2. Ducts or Plenums: Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density. FSK Jacket.

D. Supply-air duct insulation outside the building thermal envelope shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density. Field-applied jacket: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.
2. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density. Field-applied jacket: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.

E. Supplement the insulation of internally lined return-air ducts and plenums outside the building thermal envelope with one of the following:

3. Ducts: Mineral-Fiber Blanket: 1 inch (25 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density. Field-applied jacket: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.

4. Ducts or Plenums: Mineral-Fiber Board: 1 inch (25 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density. Field-applied jacket: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping.
 - 2. Refrigerant suction piping.
 - 3. Chilled-water piping, indoors and outdoors.
 - 4. Heating hot-water piping.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Equipment Insulation."
 - 2. Division 23 Section "Duct Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Environmental Submittals, Product Data: For adhesives and sealants, documentation including printed statement of VOC content.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 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.

1.5 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.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for 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 Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- 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 III with factory-applied ASJ or FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ or FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- J. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide the following:

- a. Dow Chemical Company (The); Trymer 2000 XP.
 - b. Duna USA Inc.; Corafoam.
 - c. Dyplast Products; ISO-25.
 - d. Elliott Company of Indianapolis; Elfoam.
2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
 3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thickness up to 1 inch (25 mm) as tested by ASTM E 84.
 4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Pipe Applications: ASJ or ASJ-SSL.

2.2 ADHESIVES

- A. Comply with VOC and other requirements specified in Section 018113 – Sustainable Construction Requirements.
- B. 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.
- C. Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
 1. Products: Subject to compliance with requirements, provide the following or approved equal:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Comply with VOC and other requirements specified in Section 018113 – Sustainable Construction Requirements.
- B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

- b. Vimasco Corporation; 749.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.4 SEALANTS

- A. Comply with VOC and other requirements specified in Section 018113 – Sustainable Construction Requirements.
- B. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 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 (Minus 73 to plus 149 deg C).
 5. Color: White or gray.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
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 (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
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 (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 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. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide the following:

- a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing, or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper, or 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper, or 2.5-mil- (0.063-mm-) thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper or 2.5-mil- (0.063-mm-) thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. Polyguard Products, Inc.; Alumaguard 60.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ABI, Ideal Tape Division; 488 AWF.

- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.8 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide the following, or approved equal:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, or 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- #### A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system.
- 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. If insulation is installed in multiple layers, stagger longitudinal and end seams.
- 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.
- 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 (50 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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 (100 mm) 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.

3.4 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 (50 mm) 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 (50 mm).
 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 Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Provide section of special insulation to comply with fire resistance rating, if required.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
- ### 3.5 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. 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 (50 mm) 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- 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 Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges 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.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYISOCYANURATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate insulation to valve body.
2. 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.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- B. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) o.c. and at end joints.

3.10 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

- C. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR AND CRAWL SPACE PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1/2 inch (19 mm) thick.
- B. Refrigerant suction piping (including all line from expansion device to evaporator coil):
 - 1. All Pipe Sizes: Flexible Elastomeric: 1 inch (19 mm) thick.
- C. Chilled Water and Brine, 40°F-50°F (N/A This Project) Insulation shall be Mineral-Fiber, preformed with factory jacket for at least straight sections (blanket or preformed with seal and PVC jacket allowed for fittings), to meet or exceed current IECC requirements, and of at least the following thicknesses:
 - 1. NPS 1-1/2 (DN 35) and Smaller: 1-1/2" thick.
 - 2. NPS 2 (DN 50) and Larger: 2" thick.
- D. Heating-Hot-Water Supply and Return, 105°F-200° F Insulation shall be Mineral-Fiber, preformed with factory jacket for at least straight sections (blanket or preformed with PVC jacket allowed for fittings), with thermal resistance to meet or exceed current IECC requirements, and of at least the following thicknesses:
 - 1. NPS 1-1/2 (DN 35) and Smaller: 1-1/2" thick.
 - 2. NPS 2 (DN 50) and Larger: 2" thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):
 - 1. For UV-resistant PVC pipe, no insulation is required.
 - 2. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3/4 inch (19 mm) thick.
- A. Refrigerant Piping:
 - 1. Liquid lines: Insulation shall be Elastomeric Foam, 3/4 inch (19 mm) thick.
 - 2. Suction lines (temperature above 40 Deg F (5 Deg C)): Insulation shall be Elastomeric Foam, 1" (25 mm) thick.
- B. Chilled Water (N/A This Project):
 - 1. All Pipe Sizes: Insulation shall be Polyisocyanurate with thermal resistance to meet or exceed current IECC requirements, and at least 2 inches (50 mm) thick.

3.14 INDOOR AND CRAWL SPACE FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Exposed Elastomeric Insulation: Apply PVC jacket or ASJ over UV-protective paint-on coating.
- D. Mineral Fiber Insulation: Elbows and fittings: Fitted PVC fitting covers, 20 mil. For cold piping, provide vapor seal using field-applied FSK or ASJ or other approved method prior to final covering.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Mineral Fiber Insulation: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.
- D. Polyisocyanurate Insulation: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.
- E. Elastomeric Insulation: Aluminum, Stucco Embossed, with Z-shaped locking seam: 0.024 inch (0.61 mm) thick.

END OF SECTION 230719

**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 ₂ 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 position do 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 1/2" 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-m² 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 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Water source heat pump heating/cooling loop piping.
 - 2. Makeup-water piping.
 - 3. Air-vent piping.
 - 4. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 125 psig (kPa) at 200 deg F (93 deg C).
 - 2. Chilled-Water Piping: 125 psig (kPa) at 200 deg F (93 deg C).
 - 3. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
 - 4. Air-Vent Piping: 200 deg F (93 deg C).
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 3. Air control devices.
 - 4. Chemical treatment.
 - 5. Hydronic specialties.

- B. Environmental Product Data Submittals:
 - 1. For solvent cements and adhesive primers, documentation including printed statement of VOC content.
- C. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, flexibility provisions, and attachments of the same to the building structure.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.
- C. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.9 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. 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. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company.
- C. Wrought-Copper Unions: ASME B16.22.
- D. **Swage Fittings: Press-on Wrought-Copper Fittings**
 - 1. **Fittings with integral, captive gasket, for application with compatible pressing tool as directed by the tool and fitting manufacturer(s) to achieve the specified piping system purpose and design test pressures and temperatures.**
 - 2. **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. **Nibco**
 - b. **Propress**

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings:
 - 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. Anvil International, Inc.
 - b. Central Sprinkler Company; a division of Tyco Fire & Building Products.

- c. National Fittings, Inc.
 - d. S. P. Fittings; a division of Star Pipe Products.
 - e. Victaulic Company.
- 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
 - 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. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.

- c. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Central Plastics Company.
 - c. Pipeline Seal and Insulator, Inc.
- 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

D. Dielectric Nipples:

- 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. Elster Perfection.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
- 2. Description:
 - a. Standard: IAPMO PS 66
 - b. Electroplated steel nipple. complying with ASTM F 1545.
 - c. Pressure Rating: 150 psig (2070 kPa) at 225 deg F (107 deg C).
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

2.5 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Diaphragm-Operated, Pressure-Reducing Valves: N/A This Project
- C. Diaphragm-Operated Safety Valves: N/A This Project

2.6 AIR CONTROL DEVICES

- 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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: **NPS 1/8 (DN 6)**.
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

D. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/4 (DN 8).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

E. Bladder-Type Expansion Tanks:

1. Refer to expansion tank schedule on the drawings
2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

F. In-Line Air Separators:

1. Refer to schedule on the drawings
2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
3. Maximum Working Pressure: Up to 175 psig (1207 kPa).
4. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

2.7 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.8 HYDRONIC PIPING SPECIALTIES

- A. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 2. End Connections: Threaded or flanged to match equipment connected.
 3. Performance: Capable of 3/4-inch (20-mm) misalignment.
 4. CWP Rating: 150 psig (1035 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- B. Stainless-Steel Flexible Connector with Integral Flow Straightening Vanes
1. Provide combination flex connectors with straightening vanes where indicated in plan details for pump entry and exit flow.
 2. Subject to compliance with requirements provide the following products or approved equal:
 - a. Metraflex Model "Suction Diffuser Flex" - Stainless Hose & Braid Flexible Connector w/Integral Rotational Vanes and
 - b. Metraflex "Model VaneFlex(r) - Stainless Hose & Braid Flexible Connector w/Integral Straightening Vanes:
 3. Flexible hose section to be 304 stainless steel, close pitch, annular corrugated hose with a type 304 braided outer covering. End connections to be ANSI class 125 or 150 carbon steel plate flanges as required by pump/pipe/adjacent accessory connections. Overall length to allow for a minimum of 1/8" intermittent flexing or per manufacturer's recommendations for additional motion.
 4. Connectors mounted at the suction side of pumps shall be located upstream of the inlet elbow, and incorporate specially designed stationary vanes that impart a rotational motion as the fluid enters the elbow. Vanes to be capable of counteracting elbow induced turbulence, enabling the fluid to negotiate the turn uniformly, and exit with a flat velocity profile.
 5. Connectors at the discharge side of pumps shall incorporate internal flow straightening vanes to reduce turbulence prior to the balancing valve. Vanes to be capable of reducing discharge turbulence equal to 5-10 pipe diameters of straight pipe, while allowing full rated movement of the connector.
- C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (860 kPa).
- D. High efficiency Low Pressure Drop Y-pattern Strainers
1. Provide high efficiency low pressure drop strainers at pump assemblies where indicated in plan details.
 2. Provide "Metraflex LPD Y Strainer" or approved equal product satisfying requirements below
 - a. Strainer shall be of low pressure drop design having the following Cv values or better:
 - 1) 3" pipe – 227
 - 2) 4" pipe – 457
 - 3) 6" pipe – 976
 - 4) 8" pipe – 1607
 - 5) 10" pipe – 2574
 - b. Strainer body shall be ASTM A126-B Cast Iron.
 - c. Screens shall be Type 304 Stainless steel.
 - d. Screen perforations shall be;
 - 1) For liquid service for sizes 2" – 3" perforation shall be .045"
 - 2) For liquid service for sizes 4" – 12" perforation shall be .125"
 - 3) For steam service for sizes 2" – 6" perforation shall be .045"

- 4) For steam service for sizes 8" – 12" perforation shall be .062"
- e. Screens shall be removable via a access cover sealed with O-ring.
- f. Strainer shall be manufactured with .25" pressure differential ports, with one placed on each side of the screen.
- g. Strainer shall be equipped with a dry well port. Port shall be .5" for sizes 2" – 3" and 1" for sizes 4" – 12".
- h. Strainer connection shall be 125 or 150 lb. class flange.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. General: Where multiple types are listed, choice is contractor's option.
- B. Hot-water heating piping, aboveground:
 1. NPS 2 (DN 50) and smaller: Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered **or swaged** joints.
 2. **NPS 1 (DN 25) and smaller:** Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
 3. **NPS 1-1/4 (DN 32) and larger:** Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and **welded and flanged joints**.
 4. For modification or extension of an existing run **NPS 2 (DN 50) and smaller:** any piping method above may be used.
- C. Chilled-water piping, aboveground:
 1. NPS 2 (DN 50) and smaller: Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered **or swaged** joints.
 2. NPS 1 (DN 50) and smaller: Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
 3. NPS 1-1/4 (DN 32) and larger: Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and welded and flanged joints.
 4. For modification or extension of an existing run NPS 2 (DN 50) and smaller: any piping method above may be used.
- D. Makeup-water piping installed aboveground shall be the following:
 1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.
- F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
- G. Condenser-water piping (including water source heat pump systems cooling tower and loop water piping), aboveground:

1. NPS 2 (DN 50) and smaller: Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered **or swaged** joints.
2. NPS 1 (DN 50) and smaller: Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. NPS 1-1/4 (DN 32) and larger: Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and welded and flanged joints.
4. For modification or extension of an existing run NPS 2 (DN 50) and smaller: any piping method above may be used. Use dielectric unions at joining of dissimilar metals.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves where indicated and at supply connection to each piece of equipment.
- B. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
- C. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, **NPS 3/4 (DN 20)** ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- N. Install branch connections to mains using tee fittings in main pipe.
- O. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- P. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated. Exception: Provide grooved end connections where equipment is configured for them.
- R. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
- S. Provide piping flexibility and expansion provisions as indicated on the drawings. In addition to specific provision indicated, provide general piping flexibility to avoid the need for expansion fittings or pipe spring type expansion loops.
 - 1. Do not tightly constrain piping horizontally except at equipment, building penetrations and other necessary points. Where practical, support each pipe on flexible suspension rods of sufficient length to allow free movement without excessive rod deflection. Where rods of sufficient length are not practical, lay piping NPS 4 and smaller unconstrained and protected with saddles on horizontal supports.
 - 2. Provide manufactured flexible connectors between piping and vibrating equipment.
 - 3. For NPS 2-1/2 or larger piping, contractor may utilize pairs of grooved piping connectors or fittings with angular deflection tolerance to create "hinged" swing joints or loops between points of constraint. Follow guidelines of manufacturer of grooved couplings and/or or angular deflection devices. Submit layout for engineer's review.
 - 4. For NPS 1 or smaller piping segments, make lengths and routes between points of restraint (such as larger mains and equipment connections) so that piping can be easily deflected by hand as far as 1/4" per 100' expansion would move it.
- T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."
- X. For welded pipe, whether to be insulated or not, grind welds smooth and paint with one coat of primer prior to further insulation or painting.
 - 1. Primer, Alkyd, Anti-Corrosive for Metal
- Y. Paint bare steel piping with one coat of primer and two coats of high-gloss industrial enamel, color according to the existing facility color code.
 - 1. Primer, Alkyd, Anti-Corrosive for Metal
 - 2. Paint, Alkyd, Exterior Gloss (Gloss Level 6)

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
 - 5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
 - 6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
 - 7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
 - 8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 - 5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 - 6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
- E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE 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 "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- E. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

- A. Retain the services of a qualified water treatment specialist acceptable to the Owner. Provide cleaning and passivation of any new pipe or equipment added to the system. Provide initial treatment of fill water added to the system following installation. Fill in this project is limited to refilling what is drained to facilitate the installation.
- B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- C. Add initial chemical treatment and maintain water quality for the first year of operation.

3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Bell and Gossett Series 80 SC In-Line Centrifugal Pump (REF: Pump Schedule on the Drawings) or approved equal product by one of the following:
1. Armstrong Pumps Inc.
 2. TACO Incorporated.
- B. COMPONENTS
1. The pumps shall be close-coupled, inline for vertical or horizontal installation, in cast iron stainless steel fitted construction specifically designed for quiet operation. Suitable standard operations at 225°F and 175 PSIG working pressure (or optional operations at up to 250°F and 250 PSIG working pressures). Working pressures shall not be de-rated at temperatures up to 250°F. The pump internals shall be capable of being serviced without disturbing piping connections.
 2. As an option an EPR/Carbon/Tungsten/Carbide/SS seal (250°F maximum operating temperature), FKM/Carbon/Ceramic/SS seal, or EPR-Silicon Carbide/Silicon Carbide/SS seal may be used in lieu of the standard Buna/Carbon/Ceramic/SS seal (225° F maximum operating temperature).
 3. The pumps shall have a solid alloy steel shaft that is integral to the motor. A non-ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.
 4. The motor bearings shall support the shaft via heavy-duty grease lubricated ball bearings.
 5. Pump shall be equipped with an internally flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Seal assembly shall have a stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face. (As an option, a stuffing box designed may be used in lieu of the traditional internally flushed mechanical seal design. Pump shall be flushed single seal, flushed double seal, or packing gland type seal arrangements.)
 6. Pump shaft shall connect to a stainless steel impeller. Impeller shall be hydraulically and dynamically balanced to Hydraulic Institute Standards ANSI/HI 9.6.4.5-2000. The allowable residual imbalance conforms to ANSI grade 6.3, keyed to the shaft and secured by a stainless steel locking capscrew or nut.
 7. Pump should be designed to allow for true back pull-out access to the pump's working components for ease of maintenance.
 8. Pump volute shall be of a Class 30 cast iron design for heating systems rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges (Optional 250 and 300 PSIG working pressures are available and are 250# flange drilled). Volute shall include gauge ports at nozzles, and vent and drain ports. The volute shall be designed with a base ring matching an ANSI 125# flange that can be used for pump support.
 9. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors shall have heavy-duty grease lubricated ball bearings to offset the additional bearing loads associated with the closed-coupled pump design. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications.
 10. Pumps shall conform to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.
 11. Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.
 12. Pump manufacturer shall be ISO-9001 certified.
 13. Each pump shall be factory tested and name-plated before shipment.
 14. As an option, the pump may include an internal stainless steel casing wear rings.
 15. Where noted on schedule pumping equipment may require one or all of the following optional tests: Certified Lab tests (unwitnessed), Hydraulic Institute Level B tests, or Witnessed Tests.

C. ACCESSORIES

1. Where noted on the schedule provide one mechanical seal for each model type of primary pump.
2. Where noted on schedule a Bell & Gossett Sediment Separator shall be furnished for installation on the flushing line between the pump discharge flange and the seal area. The sediment separator is installed to increase the overall life expectancy of the seal on inherently dirty systems. The separator shall remove dissolved solids from the flushing medium before the fluid enters the seal area where it can damage and shorten the life of the seal.
3. Where noted on schedule a Bell & Gossett Brazed Plate Heat Exchanger Kit shall be furnished for installation on the flushing line between the pump discharge flange and the seal area. The heat exchanger is installed to increase the overall life expectancy of the seal on high temperature systems (greater than 225° F). The kit shall decrease the temperature of the flushing water being provided to the seal area as a flushing medium to a temperature less than 225° F. Flushing temperatures higher than 225° F can damage and shorten the life of the seal.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Bell and Gossett Series 1510 Base Mounted Centrifugal Pump (REF: Pump Schedule on the Drawings) or approved equal product by one of the following:

1. Armstrong Pumps Inc.
2. TACO Incorporated.

B. COMPONENTS

1. The pumps shall be long coupled, base mounted, single stage, end suction, vertical split case design, in cast iron stainless steel fitted, specifically designed for quiet operation. Suitable standard operations at 225°F and 175 PSIG working pressure or optional operations at up to 250°F and 250 PSIG working pressures. Working pressures shall not be de-rated at temperatures up to 250F. The pump internals shall be capable of being serviced without disturbing piping connections, electrical motor connections or pump to motor alignment.
2. The pumps shall be composed of three separable components a motor, bearing assembly, and pump end (wet end). The motor shaft shall be connected to the pump shaft via a replaceable flexible coupling.
3. A bearing assembly shall support the shaft via two heavy-duty regreaseable ball bearings. Bearing assembly shall be replaceable without disturbing the system piping and shall have foot support at the coupling end. Pump bearings shall be regreaseable without removal of the bearings from the bearing assembly. Thermal expansion of the shaft toward the impeller shall be prevented via an inboard thrust bearing.
4. The bearing assembly shall have a solid SAE1144 steel shaft. A stainless steel shaft sleeve shall be employed to completely cover the wetted area under the seal.
5. Pump shall be equipped with an internally-flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Application of an internally flushed mechanical seal shall be adequate for seal flushing without requiring external flushing lines. Seal assembly shall have Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.
6. Bearing assembly shaft shall connect to a stainless steel impeller. Impeller shall be both hydraulically and dynamically balanced to ANSI/HI 9.6.4-2009, balance grade G6.3 and secured by a stainless steel locking capscrew or nut.
7. Pump should be designed to allow for true back pull-out allowing access to the pump's working components, without disturbing motor or piping, for ease of maintenance.
8. A center drop-out type coupling, capable of absorbing torsional vibration, shall be employed between the pump and motor. Pumps for variable speed application shall be provided with a suitable coupling sleeve. Coupling shall allow for removal of pump's wetted end without disturbing pump volute or movement of the pump's motor and electrical connections. On variable speed applications the coupling sleeve should be constructed of an neoprene material to maximize performance life.

9. An ANSI and OSHA rated coupling guard shall shield the coupling during operation. Coupling guard shall be dual rated ANSI B15.1 and OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling. No more than .25 inches of either rotating assembly shall be visible beyond the coupling guard.
10. Pump volute shall be of a cast iron design for heating systems with integrally cast pedestal volute support, rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges. (Optional 250 PSIG working pressures are available and are 250# flange drilled.) Volute shall include gauge ports at nozzles, and vent and drain ports.
11. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory aligned, and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications and conform to standards outlined in EISA 2007.
12. Base plate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends, with securely welded cross members and fully open grouting area (for field grouting). The minimum base plate stiffness shall conform to ANSI/HI 1.3.8.2.1- 2009 for grouted Horizontal Baseplate Design standards.
13. Pump shall be of a maintainable design and, for ease of maintenance, should use machine fit parts and not press fit components.
14. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 9.6.4-2009 for recommended acceptable unfiltered field vibration limits (as measured per ANSI/HI 9.6.4-2009 Figure 9.6.4.2.3.1) for pumps with rolling contact bearings.
15. Pump manufacturer shall be ISO-9001 certified.
16. Each pump shall be hydrostatically tested 1.5 times the maximum rated working pressure and name-plated before shipment.
17. Pump shall conform to ANSI/HI 9.6.3.1-2012 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

C. ACCESSORIES

1. Where noted on the schedule provide one mechanical seal for each model type of primary pump.
2. Where noted on schedule pumps shall be provided with internal volute wear rings, galvanized drip pan, or special spacer couplings.
3. Where noted on schedule an EPR/Carbon-Tungsten Carbide seal (250°F maximum operating temperature), or EPR/Silicon Carbide- Silicon Carbide seal should be used in lieu of the Buna standard seal (225°F maximum operating temperature).
4. Where noted on schedule a stuffing box design may be used in lieu of the traditional internally flushed mechanical seal design. Pump shall be flushed single seal or packing gland type seal arrangements.
5. Where noted on schedule, pumping equipment may require a Hydraulic Performance Test per ANSI/HI-14.6-2011, witnessed or non-witnessed test.
6. Where noted on schedule a Bell & Gossett Sediment Separator shall be furnished for installation on the flushing line between the pump discharge flange and the seal area. The sediment separator is installed to increase the overall life expectancy of the seal on inherently dirty systems. The separator shall remove dissolved solids from the flushing medium before the fluid enters the seal area where it can damage and shorten the life of the seal.
7. Where noted on schedule a Bell & Gossett Brazed Plate Heat Exchanger Kit shall be furnished for installation on the flushing line between the pump discharge flange and the seal area. The heat exchanger is installed to increase the overall life expectancy of the seal on high temperature systems (greater than 225°F). The kit shall decrease the temperature of the flushing water being provided to the seal area as a flushing medium to a temperature less than 225 F. Flushing temperatures higher than 225°F can damage and shorten the life of the seal.

2.3 DOUBLE SUCTION, HORIZONTAL SPLIT CASE PUMPS (BASE MOUNTED)

A. Manufacturer:

1. Contractor shall furnish and install new double suction horizontal split case pumps for chilled water and hot water heating systems as indicated on the drawings. Pumps shall be model HSC or HSCS as manufactured by Bell & Gossett or approved equal by TACO or Armstrong. Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings.

B. Components

1. The pumps shall be long coupled, base mounted, single stage, double suction, horizontally split case design, in cast iron bronze fitted construction specifically designed and guaranteed for quiet operation. Suitable standard operations at 225°F and 175 psig working pressure. Working pressures shall not be de-rated at temperatures up to 250°F. The pump internals shall be capable of being serviced without disturbing the upper casing half and system piping.
2. A bearing housing shall supply support for a pair of heavy-duty regreaseable ball bearings. An inboard single row bearing will absorb thermal expansive forces while an outboard double row bearing will be clamped in place to absorb both radial and thrust loads and keep the rotating element in proper axial alignment. Bearings shall be replaceable without disturbing the system piping, the upper casing half, and shall be regreaseable without removal of the bearings from the bearing housing.
3. The impeller shaft shall be a solid 416 stainless steel shaft.
4. Pump shall be equipped with a pair of internally flushed mechanical seal assemblies in direct contact with the pump shaft. Seal assemblies shall be Type 21 having a stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon-ceramic design with the carbon face rotating against a stationary ceramic face.
5. Impeller shall be of the enclosed double suction type made of bronze, both hydraulically and dynamically balanced to ANSI/HI 1.1-1.5-1994, section 1.4.6.1.3.1, figure 1.106, balance grade G6.3 keyed to the shaft and fixed in the axial position.
6. A flexible type coupling, capable of absorbing torsional vibration, shall be employed between the pump and motor. On variable speed applications the coupler sleeve should be constructed of an EPDM material to maximize performance life.
7. The coupling shall be shielded by a dual rated ANSI B15.1, Section 8 AND OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling.
8. Pump volute shall be of a cast iron (rated for 175psig Max WP) axially-split design with flanges (175 psig drilled for 125# ANSI companion flanges) and mounting feet integral cast into the bottom half of the casing. Suction and discharge flanges shall be on a common centerline in both the horizontal and vertical planes, and the volute shall include Bronze Casing Wear Rings, priming port, gauge ports at nozzles, and vent and drain ports. The upper half casing shall be capable of being removed without disturbing piping connections or electrical motor connections.
9. Pump seal flushing shall be internal within the pump casing and shall flush the seal at a rate equal to 25% of the total pump flow.
10. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory aligned, and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications and conform to the standards outlined in EPACKT 92.
11. Base plate shall be of structural steel or fabricated steel channel with fully enclosed sides and ends, and securely welded cross members. The grouting area shall be fully open. The combined pump and motor base plate shall be sufficiently stiff as to limit the susceptibility of vibration. The minimum base plate stiffness shall conform to ANSI/HI 1.3.4-1997 for Horizontal Baseplate Design standards.
12. Base shall be capable of being field grouting.
13. Pump rotation shall be righthand or lefthand as viewed from the pump end.
14. Pump manufacturer shall be ISO-9001 certified.
15. The seismic capability of the pump shall allow it to withstand a horizontal load of 0.5g, excluding piping and/or fasteners used to anchor the pump to mounting pads or to the floor, without adversely affecting pump operation.

16. Each pump shall be factory hydrostatically tested per Hydraulic Institute standards and name-plated before shipment. It shall then be thoroughly cleaned and painted with at least one coat of high-grade paint prior to shipment.

C. Accessories:

1. Where noted on schedule pumps shall be provided with internal bronze pump wear rings, special shaft materials, or special spacer couplers.
2. Where noted on schedule either balanced or unbalanced seals of EPR Carbon/Ceramic seals, EPR Tungsten/Carbide seal, or packing gland material should be used in lieu of the standard seal.
3. Where noted on schedule pumping equipment may require one or all of the following tests: Certified Lab tests (unwitnessed), Hydraulic Institute Level B tests, or Witnessed Tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 3. Construct concrete bases 3.5 inches (88 mm) high and extend base not less than 2 inches (50 mm) in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.
 4. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
- F. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment base(s) using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 1. Minimum Deflection: 1/4 inch (6 mm).

2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of concrete base.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install on 3.5-inch (88 mm) high concrete base.

3.3 ALIGNMENT

- A. Perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Refer to piping diagram on drawings for additional information about connections and related accessories.

3.5 STARTUP SERVICE

- A. Perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check piping connections for tightness.
 3. Clean strainers on suction piping.
 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 6. Start motor.
 7. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sealants and gaskets.
4. Hangers and supports.
5. Duct liner.

- 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. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 1. Sealants and gaskets.
- B. Environmental Submittals:

1. Product Data: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
5. Product Data: For adhesives and sealants, documentation including printed statement of VOC content. Include all product data as required to confirm submitted products and those related thereto (e.g. adhesives, sealants, paints, coatings, etc.) comply with VOC threshold requirements per AISD Sustainability Scorecard ALL 3MA.
6. Laboratory Test Reports: For adhesives and sealants, documentation indicating that products 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."

C. Shop Drawings:

1. Penetrations through fire-rated and other partitions.
2. Equipment installation based on equipment being used on Project.
3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
4. Mechanical room detail and coordination drawings at no smaller than ¼" scale to illustrate fit of equipment and ducts and coordination with other trades such as piping and electrical work.

1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.6 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SINGLE-WALL 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." Comply with sealing requirements in IMC 2012.
- 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." Comply with sealing requirements in IMC 2012.
- 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 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. 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:
 - 1. McGill AirFlow LLC.
 - 2. Sheet Metal Connectors, Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Comply with sealing requirements in IMC 2012.
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Comply with sealing requirements in IMC 2012.

- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 2. Coat insulation with antimicrobial coating.
 - 3. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Inner Duct: Minimum 0.028-inch (0.7-mm) [perforated galvanized sheet steel having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent] [solid sheet steel].
- H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/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." Comply with sealing requirements in IMC 2012.
- I. 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." Comply with sealing requirements in IMC 2012.

2.3 SINGLE-WALL 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Comply with sealing requirements in IMC and IECC 2012.
 - 1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- C. 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." Comply with sealing requirements in IMC and IECC 2012.

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

- 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."

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. 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:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.

- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- a. Transverse Joints in Ducts Larger Than **60 Inches (1524 mm)** in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

- b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- D. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K)** at 75 deg F (24 deg C) mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 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. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick [galvanized steel] [aluminum] [stainless steel]; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

2.7 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. Tapes or mastics used for duct sealing shall conform to UL 181A or 181B.
- C. 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 (2500 Pa), 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.
- 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 (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) 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.

2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- 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.
 - A. Comply with IMC and IECC duct system fabrication standards.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. 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 (38 mm).
- K. 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.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

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. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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. Comply with sealing requirements in IMC and IECC 2012.
- 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. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.
13. New exhaust ducts and attachments to existing ducts within Return-Air Shaft or Plenum: Seal Class A

C. Tapes or mastics used for duct sealing shall conform to UL 181A or 181B.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Refer to Division 23 Section 230529 – “Hangers and Supports for Hvac Piping and Equipment.”
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- 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.

3.5 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.

3.6 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. Paint materials and application requirements are specified in Division 09 painting Sections.
- B. All paint shall comply with requirements above AND AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 DUCT CLEANING

- A. Clean new and existing 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. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. 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, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, 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.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Notify owner upon discovery of existing fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Supply Ducts:
1. Pressure Class: Positive 2-inch wg (500 Pa).
- C. Return Ducts:
1. Pressure Class: Positive or negative 1-inch wg (250 Pa).
- E. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Positive or Negative 1-inch wg (250 Pa).
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
- F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Pressure Class: Positive or negative 1-inch wg (250 Pa).
- G. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
- H. 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 (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.
- I. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: 45-degree "boot" tap.
 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Adjustable barometric dampers.
3. Manual volume dampers.
4. Control dampers.
5. Combination fire and smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

- B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 26 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

- A. Environmental Submittals:

1. Documentation indicating that units comply with ASHRAE 62.1 Section 5 - "Systems and Equipment."
2. Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.

- b. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to [10] <Insert number> percent of amount installed.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.8 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warrant nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Basis of Design: Project is designed around the characteristics of Greenheck BR-30 Series. Subject to compliance with requirements, other manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company.
 - 4. Vent Products Company, Inc.
- B. Description: Counterbalanced.
- C. Maximum Air Velocity: 2500 fpm (10 m/s).
- D. Maximum System Pressure: 4-inch wg (0.5 kPa).
- E. Frame: 0.125-inch- (3.2-mm-) thick extruded aluminum or 16 gage galvanized steel with welded corners. Provide with integral mounting flange or other mounting or attachment provisions appropriate to application.
- F. Blades: Multiple single-piece blades, maximum 6-inch (150-mm) width, 0.060-inch- (1.6-mm-) thick extruded aluminum or 16 gage formed steel with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded PVC, neoprene or vinyl, mechanically locked.
- I. Blade Axles:
 - 1. Material: Plated, galvanized or stainless steel.
- J. Tie Bars and Brackets: Plated, galvanized or stainless steel.
- K. Bearings: Steel ball or synthetic pivot bushings.
- L. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Screen Material: Galvanized steel or aluminum.

4. Screen Type: Insect.
5. 90-degree stops.

2.3 ADJUSTABLE BAROMETRIC DAMPERS

- A. Basis of Design: Project is designed around the characteristics of Ruskin CBD4. Subject to compliance with requirements, other manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Ruskin Company.
 4. Vent Products Company, Inc.
- B. Description: Counterbalanced.
- C. Maximum Air Velocity: 2500 fpm (10 m/s).
- D. Maximum System Pressure: 4-inch wg (0.5 kPa).
- E. Frame: 4 inches x 1 inch x minimum 0.081 inch (102 x 25 x minimum 2.1 mm) 6063-T5 extruded aluminum channel with [front flange and] [rear flange and] galvanized steel braces at mitered corners.
- F. Blades:
1. Style: Single-piece, close within frame.
 2. Action: Parallel.
 3. Orientation: Horizontal.
 4. Material: Minimum 0.070 inch (1.8 mm) 6063-T5 extruded aluminum.
 5. Width: Maximum 6 inches (152 mm).
- G. Bearings: Dustproof ball bearings pressed into hole in frame.
- H. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
- I. Linkage: Minimum 1/2 inch (13 mm) aluminum tie bar with stainless steel pivot pins mounted on blades.
- J. Axles: Corrosion-resistant, long-life, synthetic, locked to blade.
- K. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade enabling damper to operate over wide range of pressures.
- L. Mounting: Select for flow orientation to fit the application.
- M. Finish: Mill aluminum.
- N. Performance Data:
1. Temperature Rating: Withstand -40 to 200 degrees F (-40 to 93 degrees C).

2. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
3. Closed Position: Maximum back pressure of 16 inches w.g. (4 kPa).
4. Open Position: Maximum air velocity of 2,500 feet per minute (762 m/min).

O. Operation of Blades at Lowest Pressure Adjustment:

1. Start to Open: 0.01 inch w.g. (0.002 kPa).
2. Fully Open: 0.05 inch w.g. (0.01 kPa).

P. Pressure Drop: Maximum 0.15 inch w.g. (0.04 kPa) at 1,500 feet per minute (457 m/min) through 24 inch x 24 inch (610 x 610 mm) damper.

Q. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGill AirFlow LLC.
 - b. METALAIRE, Inc.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
 - e. Vent Products Company, Inc.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel, full length of damper blades.
7. Bearings: Molded synthetic, at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arrow United Industries; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Ruskin Company.
7. Vent Products Company, Inc.
8. Young Regulator Company.

B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches (200 mm).
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings; full length of damper blades

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Molded synthetic.
2. At both ends of operating shaft.

3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

- A. 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:
 1. Air Balance Inc.; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Greenheck Fan Corporation.
 5. Nailor Industries Inc.
 6. NCA Manufacturing, Inc.
 7. Pottorff.
 8. Prefco; Perfect Air Control, Inc.
 9. Ruskin Company.
 10. Vent Products Company, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000 fpm (10-m/s) velocity.
- D. Fire Rating: As required for wall rating, but not less than 1-1/2 hours unless specifically noted.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 1. Minimum Thickness: 0.138 inch (3.5 mm) thick, or thicker if indicated on drawings or required to comply with listing requirements provided by manufacturer.
 2. Length to suit application and to satisfy listing requirements provided by manufacturer.
 3. Where installed in insulated duct, provide with insulated sleeve (whether integral or separate) compatible with the application.
 4. Where installed behind a grille, or opening size is otherwise restricted, fire dampers listed for "outside of wall" configuration shall be provided as needed. Provide sleeve (whether integral or separate) compatible with the application.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch- (0.61-mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.7 SMOKE DAMPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Model SD60-2M or comparable product by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
 - 1. Dynamic type is required at inlet and outlet of each AHU, since one AHU may operate in a manner that puts pressure on the other AHU's isolation dampers.
 - 2. Provide discharge dampers with modulating damper actuators to allow dampers to regulate duct pressure if fan VFD is in bypass. Provide discharge dampers suitable for 3000 fpm and 4" wg
- C. Frame: Hat-shaped, 16 gage, galvanized sheet steel, with welded corners.
- D. Blades: Airfoil, 16 gage, galvanized sheet steel.
- E. Leakage: Class II.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Damper Motors: Modulating action; coordinate voltage and control with EMS and fire alarm. Damper must modulate under EMS control normally, but be closed by fire alarm regardless of EMS signal.
- H. Accessories:
 - 1. Auxiliary switches for fan control or position indication.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Model FSD60 or comparable product by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.
- D. Fire Rating: 1-1/2 and 3 hours, as required for rating of wall or floor penetrated.
- E. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

- F. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- G. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- H. Leakage: Class II.
- I. Rated pressure and velocity to exceed design airflow conditions.
- J. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.
- K. Master control panel for use in dynamic smoke-management systems.
- L. Damper Motors: Modulating or two-position action.

2.9 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.10 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

- D. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.11 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Nailor Industries Inc.
6. Ventfabrics, Inc.
7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Materials: Flame-retardant or noncombustible fabrics.

- C. Coatings and Adhesives: Comply with UL 181, Class 1. All coatings and adhesives shall comply with requirements above AND AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Where used in ducts penetrating the building envelope, install backdraft or control dampers as close as possible to building envelope penetrations.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch (4.18-mm) steel sleeve, continuously welded at all joints and 1/2-inch- (13-mm-) diameter steel bars, 6 inches (150 mm) o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch (63-by-63-by-6-mm) steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch (300-by-300-mm) hinged access panel with cam lock in duct in each side of sleeve.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. At outdoor-air intakes and mixed-air plenums.
 - 2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 5. Upstream from turning vanes.
 - 6. Control devices requiring inspection.
 - 7. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 - 5. Body Access: 25 by 14 inches (635 by 355 mm).
 - 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

- L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts **without** flexible duct.
- P. Connect flexible ducts to metal ducts with adhesive, draw bands (for all layers duct, vapor barrier, and insulation) and sheet metal screws. Seal as specified for metal ducts in the system.
- Q. Install duct test holes where required for testing and balancing purposes.
- R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 235700 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes plate heat exchangers.

1.3 DEFINITIONS

- A. TEMA: Tubular Exchanger Manufacturers Association.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic-water heat exchangers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including heat exchanger, storage tank, and supports.
 - b. Faulty operation of controls provided by heat exchanger manufacturer.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
 - a. Plate Heat Exchangers:
 - 1) Plate-and-Frame Type: Five year(s) from date of substantial completion. Warranty shall include gaskets and replacement thereof if deficient.

PART 2 - PRODUCTS

2.1 GASKETED-PLATE HEAT EXCHANGERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 1. API Heat Transfer Inc.
 2. APV; a brand of SPX Corporation.
 3. Armstrong Pumps, Inc.
 4. Delta T Heat Exchangers.
 5. ITT Corporation; Bell & Gossett.
 6. Mueller, Paul, Company.
 7. Polaris Plate Heat Exchangers.
 8. TACO Incorporated.
 9. Thermo Dynamics Ltd.
 10. Tranter, Inc.
- B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.
- C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.
- D. Frame:
 1. Frame and pressure plates shall be carbon steel SA 516 grade 70 or better.
 2. Carbon steel frame components, except hardware, shall be painted with gray macro epoxy paint to a minimum of 4 mils dry film thickness.
 3. Frame plates shall have integral lifting eyes in the upper corners. Bolted or welded on lifting lugs not allowed.
 4. Units with studded port connections shall have unlined or alloy lined studded ports to mate with a raised face or flat faced ANSI flange where 150# ANSI flanges are acceptable. Rubber liners are not allowed.
 5. Units with 1" ports shall have carbon steel or 316 stainless steel female tapped NPT or alloy material male NPT connections.

6. For units with studded port type connections, the studs around the ports must be provided by the manufacturer.
7. Units with connections greater than 3" require that the thermal plates be supported by the top carry bar. The bottom guide bar shall only assist in properly aligning the plates.
8. The design for units with 2.5" connections or smaller shall allow the plates to be supported by the bottom guide bar and the top carry bar shall help properly align the plates.
9. The carry and guide bar for 2" port models shall be stainless steel. For models with 2.5" ports and greater, the thermal plate contact surfaces of the carry and guide bar shall be stainless steel. For units with 1" connections, the carry and guide bars shall be zinc plated carbon steel.
10. For ease of movement during assembly and maintenance, the movable pressure plate shall be supported by a roller assembly over the carry bar for 4" ported models greater than 90" in height and for all 6" and larger ported models. For 4" ported models less than 90" in height, a glide clip made of ultra high molecular weight polyethylene shall be used on the movable pressure plate.
11. Units shall have a minimum of two mounting feet at the frame plate and one at the support column, if a support column is used in the design.
12. For units with 300 psig design pressure or less, excluding "wide gap" designs, frames must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.
13. The nominal connection size shall match the nominal thermal plate port hole diameter.
14. Include provisions for anchoring to support.

E. Hardware

1. All bolting, including tightening bolts, shall be carbon steel SA193 grade B7 and galvanized via electroplating of zinc coating.
2. All nuts shall be carbon steel SA194 grade 2H and galvanized via electroplating of zinc coating.
3. Mounting feet shall be zinc plated carbon steel.
4. The tightening bolt assemblies on units with 3" and greater connections shall include lock washers at the movable pressure plate such that the unit can be opened and closed with one wrench from the front of the unit.
5. All the tightening bolt assemblies on units with 3" and greater connections shall include bearing washers at the fixed frame plate to reduce friction. Bearing assemblies only on some of the bolts is not allowed.
6. The nuts on the tightening bolt assemblies on units with 3" and greater connections shall be peened on, not welded, at the frame plate.

F. Plates

1. Min. **0.016 inch (0.4 mm)** thick before stamping; Type 316L stainless steel.
2. Plates shall be pressed in a one-step stamping process, except for plates 132" and greater in length, where multi step pressing is allowed.
3. Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable.
4. The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall either be a gasket lug which fits within a plate recess on the preceding plate (tongue in groove) to align successive plates or an extended rolled edge hanger which nests successive plates

through direct contact around the entire plate hanger. Plate designs which only offer alignment through contact with the carry and guide bar are unacceptable.

5. Plates shall have an enclosing groove for the entire gasket designed to contain the gasket while allowing for thermal expansion.
6. Plates shall be permanently marked to indicate plate material and thickness.
7. Double wall plates shall have an air gap with a leak detection path.
8. Stainless steel double wall plates shall be pressed at the same time to ensure a close fit with minimal loss of heat transfer.
9. For units with 300 psig design pressure or less, excluding "wide gap" designs, thermal plates must be designed to withstand full test pressure in one circuit with zero pressure in the opposite circuit.

G. Gaskets

1. Material as noted on drawing schedules
2. All gaskets for single pass designs, except the gasket on the first plate, shall be identical.
3. The gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.
4. Gaskets shall have tapered sides to assure positive seating of the compressed gasket and assist in aligning the thermal plates during compression.
5. When available, glue-free gaskets are preferred to glued-on gaskets. Glue-free gasket attachment methods which break during gasket removal or plate maintenance, thus destroying the gasket, are not allowed.

H. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

1. NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
2. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

I. Where indicated on drawings, enclose plates in solid **aluminum or stainless-steel** insulated removable shroud.

J. Thermal/Hydraulic Design and Certification

1. The manufacturer shall provide written guarantee to the accuracy of the heat exchanger thermal design.
2. The manufacturer shall be certified with the Air-Conditioning, Heating and Refrigeration Institute's Liquid to Liquid Heat Exchanger Certification program, AHRI Standard 400, for the Model being supplied.
 - a. For units within the scope of the program: "This heat exchanger is certified by the AHRI Liquid to Liquid heat exchanger certification program based on AHRI Standard 400. AHRI certified units are subject to rigorous testing, have performance ratings independently measured and are third party verified. Certified units may be found in the AHRI Directory at www.ahridirectory.org".
 - b. For units at operating conditions outside the scope of the program: "The operating conditions are outside of the scope of AHRI Standard 400 Liquid to Liquid

- certification program of 2000 gpm and/or 24,000,000 btu/hr. Model is an AHRI Standard 400 certified model”
3. In accordance with AHRI Standard 400, the manufacturers output/specification sheet shall have the following information:
 - a. Model Number;
 - b. Volumetric Flow Rate;
 - c. Inlet Temperatures on Both Circuits;
 - d. Outlet Temperatures on Both Circuits;
 - e. Pressure Drops on Both Circuits;
 - f. Surface Margin (also known as Excess Surface Area);
 - g. Heat Duty (also known as Heat Load);
 - h. Overall Heat Transfer Coefficient;
 - i. Heat Transfer Area;
 - j. Number of Plates;
 - k. Channel Arrangements on Both Circuits;
 - l. Number of Passes;
 - m. Plate Material and Thickness;
 4. Should the Heat Exchanger not perform to the specified conditions as defined in AHRI Standard 400, the manufacturer is responsible to replace or repair the exchanger to achieve the stated performance.
 5. If the manufacturer is not certified with the Air-Conditioning, Heating and Refrigeration Institute's Liquid to Liquid Heat Exchanger certification program, AHRI Standard 400, a witnessed factory performance test must be completed per the testing specification of AHRI Standard 400.

2.2 ACCESSORIES

A. Hangers and Supports:

1. **Factory** or **Field**-fabricated steel **supports** to ensure both horizontal and vertical support of heat exchanger. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

2.3 SOURCE QUALITY CONTROL

- A. **Factory Tests:** Test and inspect heat exchangers according to ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME label.
- B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.
- C. Heat exchangers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
- B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GASKETED-PLATE HEAT-EXCHANGER INSTALLATION

- A. Install gasketed-plate heat exchanger on minimum 4" concrete housekeeping pad or custom-designed wall supports anchored to structure as indicated on Drawings. Anchor heat exchanger frame to pad or wall supports in accordance with manufacturer's instructions.
- B. Where required, install metal shroud over installed gasketed-plate heat exchanger according to manufacturer's written instructions.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Maintain manufacturer's recommended clearances for plate removal, service, and maintenance.
- C. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.
- D. Install shutoff valves at heat-exchanger inlet and outlet connections.
- E. Install gauge ports on heat-exchanger inlet and outlet piping. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Heat exchanger will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports. Submit to Owner and A/E. Place copy of passing reports in O&M manuals.

3.5 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

- A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, clean, and maintain heat exchangers.

END OF SECTION 235700

SECTION 237100 - ROOF-RELATED MECHANICAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The relocation, movement, disconnection and re-connection of mechanical equipment, gas lines, condensate lines, ductwork, etc.
- B. Pre-checking of all existing roof mounted HVAC, ventilation, and related equipment. Owner will verify that all mechanical equipment is in working order prior to Work starting. The Contractor shall pre-check each unit prior to the Work and provide a written report to the Architect prior to any disruption of the units.
- C. Modification of existing gas lines with matching sizes, configuration, valves, support system, etc., as required. The Contractor shall test all gas lines in the presence of the Owner prior to the start of Work. Repair of any leaks or anomalies identified during this pre-check will be made by the Owner or by change order issued to the Contractor.
- D. Testing of roof drains in the presence of the Owner prior to the start of Work. Required repairs or opening of blockages identified during this process shall be performed by the Owner or by change order issued to the Contractor.
- E. All heating, air conditioning and ventilation Work shown in the Drawings and as indicated herein, or as may be implied by the Work.
- F. Lifting, moving, re-setting and/or modifications to existing equipment and curbs, including gas, condensation and electrical service lines, etc., whether shown on the Drawings or not.
- G. Installation of all sleeves and the cutting and patching of all holes necessary for the convenient and proper installation or disconnects and reconnections of the Work.
- H. Any Work installed without regard to the Work of other trades which must, in the opinion of the Architect, be relocated to permit the installation of other Work, shall be moved and reinstalled as a part of this Work without additional cost to the Owner.
- I. Existing conditions such as pavements, sidewalks, interior and exterior finishes and other Work shall be restored to their original or better condition where disturbed by Work of this Section.
- J. Notify the Architect and Owner's representative a minimum of 72-hours in advance of the disconnection or re-location of any mechanical, plumbing or electrical line or appliance. Notification shall be weekdays and not include weekends.

1.2 RELATED REQUIREMENTS

General Conditions, Supplementary General Conditions, Forms, Specification Sections, and all Drawings apply to Work specified in this Section.

1.3 RELATED SECTIONS

- A. Division 06 Section – Miscellaneous Rough Carpentry
- B. Division 07 Section – PVC and Modified Bituminous Roofing
- C. Division 07 Section – Roof Removal Procedures
- D. Division 07 Section – Flashing and Sheet Metal
- E. Division 07 Section – Roofing Accessories
- F. Division 07 Section – Roof-Related Electrical Provisions

1.4 QUALITY CONTROL

- A. The Mechanical and Plumbing Contractor(s) performing Work under this Section shall be company(ies) qualified in the respective trade(s) with a minimum of five (5) years documented experience in working with the systems currently existing or herein specified. The company proposed to accomplish the Work shall show the successful completion of a minimum of five (5) similar projects of matching scope and monetary size accomplished by the company over the preceding three (3) year period.
- B. The Mechanical Contractor shall carry a State of Texas Class "B" license which shall be in effect at the time the project is bid and shall be maintained throughout the duration of the project. All requirements of the license and its administration shall be met in full.
- C. All Work shall be in strict conformance to the requirements of the latest accepted edition of the Uniform Mechanical and Plumbing Codes and any other codes which might be in force in the jurisdiction in which the Work is performed.
- D. The Plumbing and Mechanical Contractors shall be licensed by the State of Texas, provide proof of having such license prior to accessing the Work site, and properly display the appropriate license numbers where required in accordance with State law.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in bulk as necessary so as to provide continuous operations and no delays in the progression of the Work. Schedule and coordinate with the Owner all necessary deliveries so as to cause the least inconvenience to the Owner's daily activities. All deliveries and unloading or loading activities shall be the responsibility of the Contractor. The Owner will not accept any responsibility for delivery activities.
- B. Store all products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store materials subject to weather and water damage in fully enclosed watertight trailers. Maintain all materials within temperature and humidity ranges required by manufacturer's instructions.
- C. For exterior storage of products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering. Provide ventilation and any required heating or cooling to avoid condensation.
- D. Store flammable products away from the building with all cans having lids sealed. Provide manufacturer's safety data sheets for all products delivered to the jobsite. Band together all loose pipe sections and stack no more than one pallet high. Store all loose fittings in marked boxes by

size and type.

- E. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.
- F. Advise the Architect in writing a minimum of seventy-two (72) hours in advance of the shutdown of any equipment or service.

1.6 SUBMITTALS

- A. Submit product data and certificates under provisions of Section 013300. Provide manufacturers printed data on all materials provided including, but not limited to the following:
 - 1. Piping and fittings.
 - 2. Pipe insulation.
 - 3. Pipe sealers, adhesives and insulation.
 - 4. Ductwork.
 - 5. Duct insulation.
 - 6. Hangers and fasteners for piping and ductwork.
 - 7. Retro fit Drain Inserts.
- B. Where significant relocation of mechanical equipment is anticipated submit shop drawings indicating the following at a minimum. Shop drawings shall be to scale and shall show all materials, fittings, new and/or existing equipment, and all incidentals to the Work required.
 - 1. Layout of ductwork and/or piping.
 - 2. Riser diagrams.
 - 3. Hanger diagrams indicating proposed attachment and locations.
 - 4. Ductwork jointing and all special sheet metal and insulating conditions.
 - 5. Mechanical curb extensions.
- C. Submit a schedule, indicating proposed time of disconnection and reconnection of existing condition, and proposed time each piece of equipment is proposed to be out of operation.
- D. Submit a plan of equipment removal and reinstallation indicating all procedures including method of evacuation and capture of fluorocarbons, controls maintenance, start-up after reinstallation, hoisting and lifting, and any other items specific to the equipment being affected.
- E. Building permits from the City of Austin, Texas are required for all mechanical, plumbing and electrical Work. Copies shall be provided to the Architect per Section 013300.

1.7 CLOSEOUT PROCEDURES AND WARRANTY

- A. Prior to Substantial Completion submit operation and maintenance instructions in accordance with the provisions of Section 017700.
- B. Maintain record drawings of conditions throughout construction indicating deviations from the original Construction Documents and/or shop drawings. Prior to Substantial Completion submit two (2) record copies of red-marked prints of the original Drawings and Shop Drawings to the Owner indicating all changes.
- C. All Work provided under this Section shall be warranted for a period of not less than one year,

beginning on the Date of Substantial Completion.

1.8 SCHEDULING

Disconnects and outages of existing mechanical equipment, ductwork, gas lines, etc., shall be scheduled at times convenience to the Owner. Times for shutdowns will be coordinated with the Contractor's and Owner's schedules beginning at the pre-roofing conference and as needed during the course of the Work.

PART 2 - PRODUCTS

2.1 MATERIAL AND PIPING SYSTEMS

A. Piping Materials:

1. Copper Tubing: ASTM B75-76.
2. Wrought Copper Solder Fittings: ANSI B16.22.
3. Steel Pipe: ASTM A53B.
4. Malleable Iron Threaded Fittings: ANSI B16.3.
5. PVC Piping: Schedule 40
6. PVC Fittings: Schedule 40.
7. Unions in Copper or Brass Lines: 125 pound all brass, screwed pattern, ground joint, as produced by Chase, Crane or Mueller.
8. Mechanical Couplings: Victaulic Style 77.

B. Natural Gas Piping:

1. All pipe 4 inches and smaller shall be either ASTM A53, Type F (continuous weld), Grade A or B (Electric Resistance Weld) black carbon steel. All pipe shall be a minimum Schedule 40. All pipe and fittings shall be of domestic (U.S.) manufacture.
2. All pipe shall be provided from the factory with end caps which shall remain in place until pipe is prepared for installation at the site. Materials found on the site without end caps shall be removed and replaced.
3. Fittings for steel pipe shall be threaded for pipe 2 inches and smaller. For pipe larger than 2 inches fittings shall be butt welding type. Flanges shall be welding neck type. All fittings shall be long-radius type. All pipe and fittings shall be of domestic (U.S.) manufacture.

C. Ductwork: New ductwork shall be minimum 24-gauge and heavier as required by existing conditions. Ductwork shall be manufactured and sealed air and watertight. Ductwork construction be strictly adhere to provisions of SMACNA.

D. HVAC Unit Curb Extensions: Where unit curbs must be extended provide 18-gauge curb extensions with fully welded joints. Seal curb extensions to existing curb and to HVAC unit to prevent air leakage. Insulate to match existing curb.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- #### A. Install piping as indicated on the Drawings or where it currently exists and as is necessitated by the

moving of associated mechanical units. The location of rooftop lines are shown schematically on the Drawings. The Contractor shall be responsible for variances of up to 5'-0" from the locations shown on the Drawings, and for any and all additional bends, fittings and supports that may be required for a complete project. The Contractor shall be responsible for determining the extent of Work required above and below the deck for any piping relocation or modifications.

- B. All systems shall be straight and true and properly graded for correct flow of contained materials, and to provide drainage. Cut pipes accurately to measurements established at the building and Work into place without forcing or springing.
- C. Make all changes in pipe sizes with reducing fittings. Use no long screws or bushings.

3.2 HOISTING

Hoist all materials and equipment to be furnished, modified, relocated or installed under this Section. Hoisting shall be compliant with all OSHA, state and federal codes and regulations.

3.3 GAS PIPING

A. General:

1. Precautions shall be taken at all times to prevent the entry of dirt or debris into new gas lines or existing parts of the system. Remove end caps only immediately prior to installation of the piping on the roof. Clean piping by purging with clean compressed air. Store pipe on hard surfaces, or in trailers at the site until ready for use. Prior to installation each pipe, fitting and valve shall be visually inspected and cleaned.
2. Cut pipe accurately to measurements established at the site and Work into place without springing or forcing. Remove burrs by reaming and install so as to permit free expansion and contraction without damage to joints or supports. Fittings are required for all changes in direction. Install piping with sufficient pitch to ensure adequate drainage and venting.
3. Piping connections to equipment shall be provided with unions or flanges. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system. Run cleaning swab through all pipe immediately prior to installation.

B. Joints:

1. Make screw joints with threads properly cut, conforming to NFP A54 and ASME B31.2 requirements. Make joints tight, with a thread joint compound resistant to and compatible with the natural gas being supplied.
2. Fusion-weld joints in accordance with ASME B31.2 - Fuel Gas Piping, unless otherwise required.
3. Make changes in direction of piping with factory fabricated screw or weld fittings only. Mitering, or notching pipe to form elbows and tees or other similar construction will not be permitted. Make branch connections with factory-fabricated screw or weld tees.
4. Use field and shop bevels for butt joints of straight pipe runs, in accordance with the recognized standards, and accomplish by mechanical means or flame cutting. Where beveling is done by flame cutting, clean surfaces of scale and oxidation prior to welding.
5. Align component parts to be welded before welding so that no strain is placed on the weld when finally positioned. Align heights as well. Make elbows and branches true. Preserve alignment during the welding operation.
6. Face flanges and unions true, and provide with appropriate gaskets, and make square and tight.

Provide union or flange joints in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as heat exchangers, air conditioning units and similar items.

7. Where the temperature of the component parts being welded reaches 32°F or lower, heat the material to approximately 100°F for a distance of 3 feet on each side of the weld before welding, and finish the weld before the material cools to 32°F.
 8. Store electrodes in a dry heated area and keep free of moisture or dampness during fabrication operations. Discard electrodes that have lost part of their coating.
 9. Provide approved anchors and suitable swing joints to control the movement of all piping subject to expansion, contraction, vibration, and flow forces.
- C. Welder's Qualifications: Provide written certification that every welder employed on the job has passed qualification tests for the piping systems to be installed as prescribed by the National Certified Pipe Welding Bureau or other reputable testing laboratory using ASME or American Welding Society procedures. Any defect found as a result of Owner directed testing shall be cause for dismissal of the welder from the project. All costs of such tests shall be borne by the Owner unless welder's test coupon or coupons fails such test, and then costs shall be paid by the Contractor.
- D. Unions and Flanges: Provide unions or flanges as applicable in piping systems at points of connection to items of equipment and elsewhere as indicated or required to permit proper connections. Locate unions or flanges so that equipment may be removed without disturbing piping system.
- E. Expansion of Piping: Provide approved anchors and suitable swing joints to control the movement of all piping subject expansion, contraction, vibration, and flow forces.
- F. Testing:
1. Following completion of the gas system on each side of the building the Contractor shall, without additional cost to the Owner, test the gas piping installation per these Specifications and applicable local codes. All leaks shall be immediately remedied and the testing reapplied. Testing shall be repeated until all leaks are repaired.
 2. Pressurize gas piping system from the nearest available isolation valve which was not a part of any portion of the natural gas piping system revisions and the various existing natural gas fired equipment to 15 inches of mercury with compressed air. Valve-off the system from the air source and observe for one (1) hour.
 3. If pressure loss occurs, determine the location of the leak(s) with soap film, repair leak and re-test.
 4. All gas lines shall be tested by or at the direction of the City of Richardson upon completion of that segment of the Work. Coordination with the Owner's maintenance personnel shall be made in advance to allow them to be present to observe the tests.

3.4 ACOUSTICS AND VIBRATION

- A. All items, new or reinstalled under this Section, which are a source of noise and/or mechanical vibration generation, shall be installed with proper attenuation provision, including absorbers, isolators or mufflers as required to prevent objectionable noises and vibrations within the building.
- B. Where absorbers or isolators are found to be deteriorated or damaged prior to equipment relocation,

such conditions shall be called to the attention of the Architect and Work shall not proceed until such time as the issue is addressed. Where these devices are determined to be in good condition they shall be reinstalled in working order.

3.5 REMOVED MECHANICAL EQUIPMENT

All mechanical equipment, wiring, copper components and controls determined to not be reused remain the property of the Owner and shall be delivered to its designated storage location on the day of removal. Any materials lost in transit shall have its value restored to the Owner. Any equipment designated to be removed and not returned to the Owner and any conduit or steel piping not reused by the Contractor shall be disposed of as part of this contract.

3.6 TESTING OF RELOCATED MECHANICAL EQUIPMENT AND LINES

- A. All HVAC and ventilation equipment which is moved or disturbed shall be tested prior to its removal and again following re-installation. Testing shall be performed prior to the equipment being disturbed. A written report containing all procedures and deficiencies identified shall be provided to the Architect prior to disturbing or moving the equipment. The Contractor shall be solely responsible for the proper operation of all roof mounted equipment following completion of the Work, with the exception of items noted in the initial inspection report.
- B. Pressure Testing:
1. The refrigerant piping shall be tested before any covering is applied, using carbon dioxide or dry nitrogen, and Freon under pressure as hereinafter specified. The high side shall be tested at 300 psig for R-12 and 450 psig for R-22. The low side shall be tested at 150 psig.
 2. Tests shall be accomplished in accordance with procedures recommended by the equipment manufacturer. The Owner shall be notified 24-hours in advance of any testing.
 3. With the test pressure in the system, all joints shall be sharply tapped with a rubber or rawhide mallet sufficiently hard to break loose any defective joints. Every joint shall then be swabbed with a soap solution. After testing, the solution shall be wiped off each joint.
 4. If any leaks are found, the pressure shall be relieved from the system; the leaking joint shall be disassembled, thoroughly cleaned, and remade as a new joint. Tests shall then be conducted again in the same order as listed above.
 5. After the system is found to be leak-free by the specified process, Freon shall be introduced with an inert gas at the same pressures, hereinbefore specified, at a rate of 0.5 lb. per ton of refrigeration. All joints shall then be carefully tested with a halide torch or electronic leak detector and any leaks found shall be repaired as specified above. After the system is found to be tight, it shall be allowed to stand under test pressure, disconnected from the pressure source, for a period of 24-hours. If the system loses pressure, other than that caused by temperature changes, then further tests for leaks shall be made.
- C. System Evacuation:
1. After completion of the above pressure tests, the system shall be evacuated using an approved auxiliary vacuum pump.
 2. Connections for evacuation shall be in accordance with the specific equipment Manufacturer's recommendations.
 3. A vacuum dehydration indicator shall be used. Dial-type gauges are not acceptable.
 4. The vacuum pump shall be operated until a vacuum in excess of 150 microns is obtained and has been maintained for a period of at least four hours. The vacuum shall then be broken with Freon and the system shall again be evacuated as specified.

- D. Charging of the systems shall be given through the charging valve in the high side passing all liquid refrigerant through a charging dehydrator. All charging lines and gauges shall be purged of air prior to connection with the system. The refrigerant shall be unused and shall be delivered in clean drums. After the system is fully charged, it shall be started and while in operation tested again for leaks with a halide torch or electronic leak detector. After successful completion of all tests, the piping will be insulated with new materials and the system placed in full operation.
- E. The Contractor shall keep accurate records of all testing and charging of the system and deliver the records to the Owner upon completion of the charging of each unit.

END OF SECTION 237100

SECTION 238146 – WATER-SOURCE HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of water-source heat pumps:
 - 1. Horizontal unit ventilators.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. Warranty: Special warranty specified in this Section.
- C. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.

1.6 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. One set of matched fan belts for each belt-driven fan.
 - 2. One set of filters for each unit.
 - 3. Two spare coaxial heat-pump unit condensers of each size and model furnished.

1.7 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Bids for substitute products shall include any and all additional provisions required to meet the design intent with the basis of design.

- 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.

1.8 COORDINATION

- A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, refrigeration components, motors, heat exchangers, controls.
 - 2. Warranty Period:
 - Reference equipment schedules on plans

PART 2 - PRODUCTS

2.1 WATER-SOURCE HEAT PUMPS

- A. Requirements on Drawings: Schedules and notes on the drawings include specific requirements that may not be repeated herein.
- B. Basis of Design: Makes and models in the Water Source Heat Pump Schedule on the drawings are the Basis of Design. Contractor must verify that any substitute products will satisfy all dimensional and performance requirements. Any modifications to piping, electrical, or building required to accommodate a substitute product must be approved by the engineer. All costs for such modifications must be borne by the contractor.
- C. Available Manufacturers:
 - 1. ClimateMaster, Inc.
 - 2. Trane
 - 3. JCI-York
- D. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.
- E. Cabinet and Chassis: Manufacturer's standard galvanized-steel casing with the following features:
 - 1. Heavy gage galvanized steel frame with ½" flexible elastomeric thermal and acoustical insulation lining.

2. Side plenum Return-air opening with front access panel for full access to internal components.
 3. Knockouts for electrical and piping connections.
 4. Cabinet Insulation: Glass-fiber liner, 1/2 inch (13 mm) thick, complying with UL 181.
 5. Condensate Drainage: Non corroding drain pan with condensate drain piping projecting to unit exterior and complying with ASHRAE 62.1.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 7. General requirements for motors are specified in Section "Motors."
- F. Water Circuit:
1. Refrigerant-to-Water Heat Exchanger: Coaxial coil type with enhanced (fluted and/or rifled) heat-transfer surfaces; leak tested to 650 psig on refrigerant side and 400 psig on water side. Heat exchanger shall be accessible and removable from the front (piping connections side) of the unit.
- G. Indoor blower
1. Fully modulating EC motor driven
 2. Internal thermal overload protection.
- H. Refrigerant-to-Air Coil: Copper tubes with aluminum fins, leak tested to 450 psig and pressure tested to 650 psig.
- I. Refrigerant Circuit Components:
1. Sealed Refrigerant Circuit: Charge with refrigerant.
 2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
 3. Charging Connections: Service fittings on suction and liquid for charging and testing.
 4. Reversing Valve: Pilot-operated sliding-type valve with replaceable magnetic coil. Reversing valve shall change position only upon change in heating/cooling mode and not with each heating/cooling call for compressor.
 5. Compressor: Hermetic multi speed scroll compressor installed on dual vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:
 - a. Anti-short cycle timer.
 - b. High-pressure cutout.
 - c. Low-pressure cutout or loss of charge switch.
 - d. Internal thermal-overload protection.
 6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
 7. Pipe Insulation: Refrigerant minimum 3/8-inch- (10-mm-) thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes per ASTM E 84.
 8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 60 to 95 deg F .
- J. Filters: MERV8 pleated. Thickness compatible with unit standard rack. 1 during construction and 1 new upon owner occupancy.
- K. Water Circulating Pump (N/A)
- L. Motorized isolation valve: a quick open, slow close motorized isolation valve shall be provided and interlocked with cooling/heating call. Provide internal time delays for compressor start to

prevent nuisance trips. Valve shall be manually overridable to keep open without requiring physical removal.

M. Controls:

1. Internal microprocessor Controls:

- a. The controller shall accept space temperature and humidity signals along with local pushbutton override and thermostat adjustments and shall internally compute fan, compressor, and valve commands in accordance with the sequence of operation on the drawings.
- b. Additionally, internal controller shall provide anti-short cycle compressor protection, random start delay, heating/cooling status, occupied/unoccupied mode, high and low pressure safety control, water and air coil low temperature cutout, under and over voltage protection, compressor status (high/low pressure), drive status (operating or failed), discharge air temperature, leaving water temperature, condensate overflow, and hot gas reheat mode status.

2. BAS Interface:

- a. Unit shall come factory furnished with communications gateway compatible with the campus BAS and able to communicate the data above as well as receive scheduled occupancy signals via the BAS communications network.

3. Refer to schedules and notes on the Drawings and to specification sections (230926a) for description of the control system functional requirements that is selected by AISD. The system composition shall include the components specifically required in the contract documents, and all other components, arrangements and connections required to achieve the operations given and comply with the local codes.

N. Electrical Connection

1. Single point electrical connection. Internally fused control power transformer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.
- B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Secure in place per manufacturer's recommendations.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with unions and shutoff valves.
 2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory technician to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

- A. Engage a factory technician to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
 2. Inspect for visible damage to compressor, coils, and fans.
 3. Inspect internal insulation.
 4. Verify that labels are clearly visible.
 5. Verify that clearances have been provided for servicing.
 6. Verify that controls are connected and operable.
 7. Verify that filters are installed.
 8. Adjust vibration isolators.
 9. Inspect operation of barometric dampers.
 10. Verify bearing lubrication on fan.
 11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 12. Adjust fan belts to proper alignment and tension.
 13. Start unit according to manufacturer's written instructions.

14. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Verify thermostat and humidistat calibration.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Start refrigeration system and measure and record the following:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Outdoor-air intake volume.
22. Measure and record the following water flow parameters.
 - a. Water flow rate.
 - b. Water pressure drop.
23. For units with water circulation pumps, measure and record the following pump parameters.
 - a. Pump head.
 - b. Motor amps.

3.6 CLEANING

- A. Replace filters used during construction prior to air balance or substantial completion.
- B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps.

END OF SECTION 238146

AISD PROJECT # 19-0040-OHNRV

SECTION 238460 – HEAT RECOVERY UNITS

PART 1 - GENERAL

1.1 PRODUCT DESCRIPTION

- A. The Heat Recovery Unit (HRU), i.e. Energy Recovery Ventilator (ERV): A stand alone energy recovery ventilator shall utilize a fixed plate enthalpic energy exchanger within a double walled all aluminum. The cabinet is supplied with or without fans, indoor or rooftop and full duct opening or one half (1/2) duct opening.

1.2 Quality Assurance

- A. The energy recovery enthalpy exchangers internal to the energy recovery ventilator shall be certified by Air Conditioning Heating and Refrigeration Institute (“AHRI”) within the AHRI Standard 1060 Certification program. At the nominal certified CFM, the enthalpy exchanger shall provide at least 60% total effectiveness for both heating and cooling conditions and 0% exhaust air transfer ratio (EATR) when tested at AHRI differential pressure between airstreams. These values are to be produced from official AHRI certification data and verification may be obtained via the www.ahri.org website which is made available to the public by AHRI to ensure proper comparison of air to air energy recovery products.
- B. The manufacturer shall provide independent testing of the enthalpy exchanger core to UL standard 900 with a flame spread result less than 25 and a smoke generation less than 50. These results meet NFPA 90A and 90B for a component within a ducted air system.
- C. The enthalpy exchanger core shall be covered by the manufacturers limited warranty to be free from manufacturing defects under normal use for a period of 10 years. The remainder of the unit shall covered by the manufacturers limited warranty to be free of manufacturing defects under normal use for a period of 2 years. **Subject to additional warranty requirements of the equipment schedule on the drawings.**

PART 2 - PRODUCTS

2.1 Standard Equipment.

- A. Enthalpic Transfer Core
 1. The enthalpy exchanger shall provide high performance sensible and latent transfer between the airstreams. This transfer shall be accomplished by moving energy (both sensible and latent) molecularly through the enthalpy exchanger surface while keeping the airstreams physically separated.
 2. The air to air enthalpy exchanger shall be of the fixed plate type and have no moving parts, surface adhered desiccants, or paper parts.
 3. The unit shall be capable of both summer and winter operation with no condensation buildup or condensate management.

AISD PROJECT # 19-0040-OHNRV

B. Unit Cabinet

1. The unit cabinet consists of an aluminum framing system and double-walled pre-painted aluminum panels. These units are available with either vertical or horizontal flow directions on both exhaust and supply.
2. The aluminum panels shall have a R-value of no less than 5.7 hr ft²/Btu.
3. Access shall be provided on unit for maintenance by removable panels in the aluminum enclosures constructed of the same material and thickness as the housing. No tools shall be required for access.
4. Rooftop units shall have outside air and exhaust air hoods with screens to prevent intrusion by birds and other animals. The roof shall be covered with a weatherproof membrane. Drip lips shall be install around the perimeter of the roof.

C. Blowers

1. When applicable, provide fans that are belt-driven, double-inlet design with forward-curved impellers. Impellers shall be dynamically balanced and designed for efficiency and quiet operation. Impellers and scroll housings shall be galvanized or powder-coated for corrosion protection.
2. Motors shall use standard NEMA frames with a totally enclosed-fan cooled enclosure and thermal overload protection. Motors shall be installed on adjustable mounting bases.
3. Fans shall be driven by V-belts using an adjustable sheave on the motor shaft and a fixed sheave on the fan shaft.

D. Filter Section

1. The filter section will be built for easy access and replacement without the use of external tools and will be provided with 2" MERV 8 pleated filters.

E. Electrical Requirements

1. All electrical connections to the unit will enter the cabinet through a single location. All fans shall be wired for single point power connection and include contactors, motor starters motor protection and 24V transformer.

F. Optional Features

1. Roof Curb Option
 - a. Formed of 18 gage galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
2. Fused Disconnect Switch Option
 - a. For 575/460 Volt power, a 30 amp, 600 volt, 3 pole, NEMA3R fused disconnect switch shall be factory installed.
 - b. For 208/230 Volt power, a 30 amp, 250 volt, 3 pole, NEMA3R fused disconnect switch shall be factory installed.
3. Disconnect Switch
 - a. For 575/460 Volt power, a 30 amp, 600 volt, 3 pole, NEMA3R fusible disconnect switch shall be factory installed.

AISD PROJECT # 19-0040-OHNRV

4. Frost Protection
 - a. The enthalpy exchanger shall operate with no frosting or condensation at outside conditions above -10 F and exhaust air RH below 40%. Infrequent incursions outside these conditions shall not impact the function of the exchanger. Drain pans are not required.
5. BAS Interface
 - a. Provide a 24-volt Class 2 power supply and terminals for connection of dry contacts controlled by the Building Automation System (BAS).
 - b. Provide a Hand-Off-Auto switch at the ERV with the Auto circuit controlled by the BAS.
6. Dampers
 - a. Units shall be provided with galvanized steel outside and exhaust air dampers controlled by 2 position, spring return actuators interlocked thru a time delay with the fan motor start contactors.
 - b. Units shall be provided with galvanized steel outside air dampers controlled by a 2 position, spring return actuator interlocked thru a time delay with the fan motor start contactors. The exhaust fan shall be provided with an aluminum gravity backdraft damper.

END OF SECTION 15846

DIVISION 24 THROUGH 25

NOT USED

DIVISION 26

ELECTRICAL

SECTION 260000 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SCOPE

- A. This project involves construction of the project as titled "Renovations at O'Henry Middle School" with associated site work as shown on the plans and described herein.

1.2 DRAWINGS

- A. Do not scale from the Drawings. Contract drawings are partially diagrammatic, and do not depict accurate locations of all elements. Contractor shall determine exact locations from field measurements. The lack of specific detail of all offsets, transitions, etc., shall not relieve the Contractor of responsibility to provide such necessary elements to coordinate his work with building construction and with other trades.

1.3 BIDDING

- A. Refer to Division 0 and Division 1 for additional bidding requirements.
- B. All bids must be based only on the equipment and materials as scheduled on the drawings and as specified or on equivalent equipment and materials from a pre-approved alternative manufacturer. No bids may be based on a substitute or other alternative without specific written prior approval from the Engineer. Any Contractor who assumes equivalence of products and who bases his bid on that assumption, does so at his own risk.
- C. A listing of approved alternative manufacturers does not mean that all products of a particular alternative manufacturer are acceptable alternatives to the scheduled items. It merely means that prior approval is not required for bidding. All fixtures and devices must still be submitted according to the prescribed procedures. In addition, some items that significantly affect building appearance may require Engineer's or Owner's approval.

1.4 INTENT

- A. All equipment, materials and labor that may be necessary to complete work in accordance with the intent of these plans and specifications shall be furnished by the Contractor without additional cost.
- B. All systems represented in the documents shall, unless specifically noted to the contrary, be provided and installed complete with all necessary components to form a complete and functioning system. Submission of bids will be considered confirmation that complete and functional systems have been included in the bids.
- C. If any discrepancies or confusion is perceived in the documents, the Contractor shall call such to the attention of the Engineer for clarification of the documents prior to bidding or construction. If any inconsistencies or contradictions within the construction documents are

discovered after the construction contracts are awarded, Engineer shall determine the intent and correct interpretation of the construction documents.

- D. Contractor shall supervise and direct the work competently and efficiently and in accordance with the drawings and specifications. Contractor shall be responsible for using construction means, methods, techniques, sequences, and procedures that are compatible with the project's requirements and will result in a project completed in accordance with the requirements of the drawings and specifications.

1.5 CODES, PERMITS AND FEES

- A. Contractor shall comply with all local, state and national codes and shall pay for all applicable costs, fees and permits.

1.6 EXAMINATION OF SITE

- A. Each contractor submitting proposal(s) for this work shall examine the site and shall take into consideration conditions that may affect the work. No information given on the plans shall relieve the Contractor of this responsibility. Submission of a bid shall be considered as compliance with the site examination requirements.

1.7 VIBRATION AND NOISE

- A. Each of the various pieces of equipment shall operate without objectionable vibration or noise. All rotating equipment shall be statically and dynamically balanced and shall be mounted, supported, and fastened so that vibration shall not exceed levels specified for the equipment item. The specific type of vibration isolation to be installed shall be submitted to the Engineer for his approval.
- B. If, in the opinion of the Engineer, or Owner, objectionable vibration or noise or transmission thereof to the building occurs, the Contractor shall execute remedial measures as may be necessary to eliminate such unsatisfactory operating conditions, and the work and material thereby required shall be furnished and performed at the Contractor's expense.

1.8 GUARANTEE

- A. Each Contractor shall guarantee all labor and materials furnished by him for a period of one year unless otherwise noted. Guarantee period shall extend from the time of final written acceptance of the installation or upon usage by a written directive from the Owner, whichever occurs first. The guarantee shall cover the repair or replacement, without additional cost to the Owner, of any defective material or faulty workmanship.

1.9 SERVICE

- A. All necessary service of each system, such as adjustment of controls, mechanical repair of equipment, and other work requiring specialized training, shall be furnished by the Contractor, at no cost to the Owner, for a period of one year, concurrent with the warranty period specified above.

1.10 SUBMITTALS

- A. Before orders are placed, Contractor shall submit specific information on list of equipment and principal materials specified. Contractor shall indicate and/or provide names of manufacturers, catalog and model numbers, cut sheets, and such other supplementary information as necessary for evaluation. Related section include Division 1, Section "Submittals." Each submittal shall include all items mentioned by model number and/or manufacturer's name in the specifications or on the drawings, including but not limited to the following:
1. Electrical - Fixtures, panels, protective devices, wiring devices, switches, motor starters, transformers, conduit, and any other equipment or principal materials.
- B. Requirements - Each submittal shall:
1. bear a stamp or specific written indication that Contractor has reviewed and approved all submittals prior to submission to Engineer,
 2. have all information deleted by Contractor that pertains to the means and methods of construction or to the fabrication, assembly, installation, or erection process (approval by Engineer shall not extend to these areas unless specifically noted by Engineer),
 3. be clearly marked as to which specific piece of equipment is being submitted, by use of a permanent marker, stamp, etc., so as to distinguish it from other pieces of equipment that may occur on the same page,
 4. be clearly marked as to which available options are being submitted that are associated with a piece of equipment, and
 5. be complete with respect to quantities, dimensions, specific performance, materials, and similar data to enable Engineer to review the proposed equipment.
 6. Omission by Contractor of any of the above requirements for submittals will subject submittal to automatic rejection without review.
 7. Any submittals received by Engineer that were not requested shall be returned without review of any kind.
 8. Include all product data as required to confirm submitted products and those related thereto (e.g. adhesives, sealants, paints, coatings, etc.) comply with VOC threshold requirements per AISD Sustainability Scorecard ALL 3MA.
- C. Substitutions
1. No substitution is allowable without Engineer's written approval ten days prior to bid due date unless the manufacturer is listed on the Drawings or in the specifications as being a preapproved alternative manufacturer. Any submittal received without such written approval or prior approval is subject to unqualified rejection.
 2. The Contractor is responsible to verify that submitted substitute equipment will fit in the space available. The Contractor's submittal for acceptance of the substitute shall include a written statement of whether or not such acceptance would require any subsequent or associated changes to the drawings or specifications. Any such changes shall be described in writing, briefly but completely.
 3. The Contractor shall be responsible for the cost of any such modifications due to substitution of materials or equipment for that which was specified or scheduled. The cost shall be complete, that is, it shall include the cost effect on any and all other trades.
 4. The Engineer may request shop drawings of mechanical rooms or systems of the substituted equipment.

1.11 SAFETY

- A. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work, and Contractor shall comply with all laws governing safety, specifically the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", state and federal.

1.12 COORDINATION

- A. Each Contractor's bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Failure on the part of the Contractor to coordinate with all other trades resulting in interference's shall be sufficient reason to require the Contractor to replace or rebuild the work involved at no extra charge.

1.13 STORAGE OF MATERIALS

- A. Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be rain-proof and lockable as required. Materials or equipment stored on site but not in a lockable, rain-proof storage facility shall be stored above ground or above slab. Contractor shall take necessary precautions to prevent entry of and/or damage from dirt, trash, water, or vermin. Equipment not properly stored and protected shall be, at the discretion of the Engineer, replaced at no cost to Owner. Roofs are not acceptable storage areas unless specifically allowed in writing by the Engineer.

1.14 CERTIFICATION LABELING

- A. Each device for which an independent testing authority has established a standard shall have affixed a label indicating its compliance and listing. Such independent testing authorities shall include, but not be limited to, the following:

A.N.S.I.	American National Standards Institute
A.S.T.M.	American Society for Testing and Materials
F.M.	Factory Mutual
N.B.S.	National Bureau of Standards
N.E.C.	National Electric Code
N.E.M.A.	National Electrical Manufacturers Association
N.F.P.A.	National Fire Protection Association
S.B.C.C.I.	Southern Building Code Congress International
U.L.	Underwriters Laboratory

1.15 SITE VISIT REPORTS

- A. During the course of the job, the Engineer will make site visits to observe work in progress and will subsequently prepare a written site visit report which will be distributed to the General Contractor and to whomever else the Engineer desires.

1.16 CUTTING, PATCHING, AND PENETRATIONS

- A. No joists, beams, girders, columns, slabs, or other structural elements shall be cut, drilled, or altered in any way by the Contractor without first obtaining written permission and instructions from the Engineer.
- B. Where cutting any non-structural element(s) of walls, floors or ceilings is necessary to permit the installation of any work under this contract, or to repair any defects that may appear up to the expiration of the guarantee, such cutting shall be done by Contractor with as little damage as reasonably possible to the element being cut, to adjacent elements, or to the work of other trades.
- C. After the necessary work has been completed, the damage shall be repaired by the Contractor, who shall pay all costs of such cutting and patching. All patching or sealing of cuts, penetrations, etc., including final appearance of same, shall be done to the approval of the Engineer.
- D. Where a penetration or cutting of a ceiling, wall, or other building membrane is required or made, each such penetration or cut shall be made neatly with a cutting tool such as a saw, sharp knife, etc., and not with an impact tool such as a hammer, screwdriver, wrench, crowbar, etc. Each such penetration or cut shall be no larger than reasonably necessary, and penetrations in occupied or publicly accessible spaces shall have a chrome-plated escutcheon installed large enough to cover the entire opening.

1.17 FIRESTOPPING

- A. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials selected and applied according to a design certified by a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction. Submit firestopping design for each type of construction and penetrant before applying it.
- A. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

1.18 OPERATING TESTS

- A. General
 - 1. After all electrical systems have been completed and put into operation, Contractor shall subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation. All associated costs of such tests shall be borne by the Contractor.
 - 2. Contractor shall make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. The Contractor shall return to the project during the first year and in the opposite season from which the system was initially operated and shall check the proper operation of the electrical systems. Contractor shall perform any adjustments or corrective procedures required for the proper operation of all systems.

3. Refer also to Section 260100 - Commissioning of Electrical Systems

B. Notification

1. Contractor shall give the Engineer seven days prior notification of any test so that the Engineer will have time to be present if he so desires.

C. Reports

1. After each test is performed, the Contractor who performed the test shall prepare and issue a report to include the following information:
2. Project name and location, date of the report,
3. Contractor's name, address, and telephone number; if the Contractor performing the test is a Subcontractor, indicate also for whom the test is being performed, their name, address, telephone number, and a contact person's name,
4. the date, or range of dates, of the test,
5. the name of the Contractor's employee who was responsible for performing or for overseeing the performing of the test,
6. a brief description of the system being tested,
7. a brief description of the testing procedure,
8. a summary of the test result(s),
9. a brief assertion that the system was tested as stated and that the system complied with the requirements of the contract documents or those of the Authority Having Jurisdiction, whichever is the most stringent, and
10. a hand-written date and signature of someone who has authority or responsibility from the company that performed test(s), and a hand-written brief note stating that the above information is true and accurate.
11. If the tested system is tested in parts, then one report may be made after the last part is tested.
12. The report shall be issued to the Engineer within five working days after the test is completed.
13. Such reports shall be required of all mechanical or electrical systems which require tests for pressure, water tightness, flow, resistance, or conductivity.
14. Services of a Manufacturer's Representative
 - a. For all major systems or equipment required by subsequent specifications sections to have tests or inspections by a manufacturer's representative, the manufacturer's representative shall prepare a written report to be sent to the Engineer for subsequent distribution to the Owner, General Contractor, and to whomever else the Engineer deems necessary. The report shall include at least the following:
 - 1) date of the visit, name and title of the representative, name and location of the project,
 - 2) name and title of any observers,
 - 3) a brief description of the equipment being inspected and/or tested,
 - 4) a brief discussion of the quality of the installation including any important items (in the manufacturer's experience) that were done correctly, as well as any items that were done incorrectly or not to recommendations,
 - 5) a list of tests and/or inspections performed and the results of same, and

- 6) a brief statement of whether the installation conforms to manufacturer's recommendations and/or requirements, and if not what is required to bring the installation into conformance.
- b. Deficiencies and Defects
- 1) Contractor shall be responsible for providing all labor and materials, at no cost to anyone except Contractor, to correct any deficiencies or defects reported by manufacturer's representative.
 - 2) If, in the opinion of the manufacturer's representative, the deficiencies and defects are sufficiently serious, then Contractor shall arrange for, and bear all costs of, another inspection by manufacturer's representative after corrective measures have been taken.
 - 3) The above process shall continue until the manufacturer's representative approves the installation.

PART 2 - PRODUCTS AND WORKMANSHIP

2.1 MATERIALS

- A. All materials shall be new and of the quality specified. Materials shall be free from defects. Where manufacturers' names are mentioned in these specifications or on the plans, it has been done in order to establish a standard of quality and construction.
- B. Contractor will be responsible for transportation of his materials to and on the job, and will be responsible for the storage and protection of his materials and work until the final acceptance of the job. At the end of each work day, each Contractor is responsible for covering or protecting his work or materials that may be susceptible to damage even if such damage is the result of unforeseen causes, e.g. an overnight thunderstorm. Failure to do so will be sufficient cause for rejection of any item in question, and any such item shall be replaced at Contractor's expense.
- C. Contractor shall verify that all pieces of equipment will fit through available openings in building and that all equipment can be installed without modification of building structure.

2.2 WORKMANSHIP

- A. The workmanship shall, in all respects, be of the highest grade, and all construction shall be done according to the best practices of the trade. Piping, ducting and conduit shall be concealed unless otherwise noted, and installed square to the building lines. Any work not meeting this requirement shall be replaced or rebuilt without extra expense to the Owner.

2.3 ROOF PENETRATIONS, EQUIPMENT AND PIPING SUPPORTS

- A. Supports for equipment, conduits, ductwork, etc. shall be provided and installed under this Contract. The Mechanical, Electrical, and Plumbing Contractor shall coordinate as to locations of supports, sizes and weights of devices or equipment being supported, etc.

2.4 ACCESSIBILITY

- A. Access Panels: Access panels shall be provided wherever necessary for possible future replacement, adjustment, or maintenance of operating devices such as machinery, valves, dampers, switches, relays, etc., or to other critical non-operating devices such as pull boxes, inspection parts, gauges, etc. Such access panels shall be provided and installed by Contractor, whether or not shown on drawings, and shall be brought to the attention of Engineer for his approval of type, color, etc. Where access is provided in rated members, the access panels shall be of a type that maintains the integrity of the member penetrated.
- B. Access to Equipment
 - 1. All pipes, tubing, conduit, etc., including, but not limited to, electrical conduit, and wiring not in conduit shall be installed in such a way so as not to prevent and/or not to make unreasonably difficult the removal, operation, use, or maintenance of equipment, access panels or doors, pathways (especially in attics or crawl spaces), observation ports, measurement or balancing devices, junction boxes, etc..
 - 2. If access for these purposes is prevented or made unreasonably difficult in the opinion of the Engineer or Engineer, then the Contractor shall make modifications or repairs at no cost to anyone except the Contractor. Such modifications or repairs shall be considered neither complete nor adequate until the Engineer is satisfied that access for the above purposes is achieved.

PART 3 - RECORDS AND SERVICES FOR THE OWNER

3.1 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall prepare and provide four copies of operating and maintenance manuals. Contractor shall deliver these four bound sets to the Engineer for approval. Each manual shall be in a ring binder and shall be indexed with dividers for each section. Delivery of required documents is a condition of final acceptance.
- B. Each manual shall contain at least the following:
 - 1. Certificates of acceptance from inspecting authorities,
 - 2. Waiver of all liens,
 - 3. For each piece of equipment:
 - a. operating and safety instructions, service manuals, and parts lists applicable to each item of equipment furnished (Contractor shall clearly distinguish in the manual between information that pertains to the particular equipment and information which does not.),
 - b. nameplate data and design parameters for equipment,
 - c. name, phone number, and address of vendor, manufacturer's representative, and warrantee provider,
 - 4. copies of all shop drawings and as-built drawings (as-built drawings shall be on a reproducible vellum as produced by a Xerox or photographic process),
 - 5. copies of all approved submittals,

6. warranties with start dates and end dates for each piece of equipment and/or for each system (warranties shall begin on date of substantial completion and acceptance by Owner),
7. names, phone numbers and addresses of all subcontractors, vendors, manufacturer's representatives, and warrantee providers,
8. acceptance letter from each Contractor with blanks for date of acceptance and date of expiration of warranties and guarantees.

3.2 INSTRUCTIONS FOR OWNER

- A. Contractor shall instruct the Owner's operating personnel in the operation and maintenance of all mechanical equipment. Contractor shall furnish any special servicing tools required for maintenance.

3.3 DEMONSTRATION

- A. Contractor shall conduct a demonstration of the installation upon completion of the work. Prior to this, all work shall have been completed, tested, balanced, and placed in operation. Qualified persons must be present at demonstration to operate all systems and prove the performance of the equipment. The schedule for this demonstration shall be coordinated with the Engineer.

3.4 REQUIREMENT

- A. The above data and work is a requirement for final acceptance and payment of the project.

END OF SECTION 260000

SECTION 26 01 00**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 019113 – “GENERAL COMMISSIONING REQUIREMENTS” for general commissioning process requirements.
 - 2. Division 22 Section 220100 – “COMMISSIONING OF PLUMBING SYSTEMS”.
 - 3. Division 23 Section 230100 - “COMMISSIONING OF MECHANICAL SYSTEMS”.

1.3 DEFINITIONS

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS.

1.4 CONTRACTOR’S COMMISSIONING RESPONSIBILITIES

- A. Refer to section 019113 - GENERAL COMMISSIONING REQUIREMENTS.
- B. Prepare submittals
- C. Review pre-functional/installation checklists prepared by CxA for electrical system components.
- D. Complete pre-functional/installation checklists prepared by CxA.
- E. Provide competent technical personnel, tools, equipment, and manpower to assist CxA during field-verification of pre-functional checklists completed by Contractor.
- F. Provide competent technical personnel, tools, equipment, and manpower to assist CxA during functional testing of electrical systems and equipment.
- G. Correct deficiencies identified by CxA in Commissioning Log, as directed by Design Team.

- H. Accompany CxA during verification of corrective action.
- I. Provide training.
- J. Provide O&M and As-built documentation
- K. Provide test data, inspection reports, and certificates.

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 pre-functional/installation checklists and manufacturer's pre-start and startup checklists for plumbing systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certification that installation, pre-start checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for pre-functional third-party verification by CxA.
 - 6. Certificate of readiness certifying that plumbing systems, subsystems, equipment, and associated controls are ready for functional third-party testing by CxA.
 - 7. Test and inspection reports and certificates.
 - 8. Corrective action documents.

1.6 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.
- C. Electrical equipment submittals and installation manuals.
- D. Electrical shop and coordination drawings required for Commissioning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to section 019113 - 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. Refer to Section 019113 - 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.
- C. Contractor shall participate in Pre-Functional testing activities to document electrical work associated with mechanical and plumbing systems.
- D. Do not proceed with system start-up or functional testing until after CxA has conducted third-party verification of pre-functional checklists.

3.3 SYSTEM START-UP

- 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.

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 ample 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.

2. Receptacle and Device Test:

- a. Test receptacle with a receptacle circuit tester for proper polarity.
- b. Test each receptacle or branch circuit breaker having ground-fault circuit protection.

D. Lighting Systems:

1. Light Fixtures: Verify all lamps work without flicker.
2. Verify light levels
3. Light Switches: Verify switches control lights per design
4. Lighting Controls:
 - a. Verify sensors pick up motion and turn on lights immediately.
 - b. Verify that lights turn off after specified time.
 - c. Verify sensor coverage includes entire room area being sensed.
 - d. Verify sensor does not pick up occupancy outside the area sensed.
 - e. For ceiling mounted occupancy switches, verify light switches still function in circuit.

5. Emergency Egress: Verify operation of emergency egress lighting and associated light levels.

E. Transformers

1. Verify primary and secondary voltages are within acceptable range and secondary voltage taps (where applicable) are appropriate.
2. Document phase to phase and phase to neutral voltages.
3. Document ground resistance
4. Verify transformers operate without "hum".

F. Emergency Generator Systems and Transfer Switches

1. Megger test insulation and ground resistance.
2. Verify phase rotation and consistency.
3. Notify CxA to witness manufacturer's start-up procedure to include:
 - a. No-load test
 - b. Load-bank test
 - c. Building-load test (witness activation of transfer switch and generators upon a real building power loss)
 - d. Other tests as specified
 - e. Provide copy of manufacturer's start-up report.
4. Document response of building systems upon a real building power-loss, activation of generator, and return of normal power.
5. Provide infrared scanning report.

3.6 TRAINING

- A. Refer to sections 019113 - GENERAL COMMISSIONING REQUIREMENTS.

3.7 O&M MANUALS

- A. Refer to sections 019113 - GENERAL COMMISSIONING REQUIREMENTS and section 017800 CLOSEOUT SUBMITTALS.

END OF SECTION 26 01 00

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. 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 – “Control-Voltage Electrical Power Cables” for wiring of control circuits.
 - 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. 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

C. Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Type(s)THHN/THWN-2 and XHHW-2.

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.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders and branch circuits, 50 V to 600 V: Type THHN/THWN-2 single conductors in raceway.

B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

C. Class 1 Control Circuits: Type THHN/THWN-2 or Type XHHW-2 single conductors in raceway.

D. Class 2 Control Circuits: Type THHN/THWN-2 or Type XHHW-2 single conductors in raceway; or power-limited cable, suspended above ceiling or concealed in walls or chases.

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. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. 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.
- C. If existing aluminum conductors are encountered and it is not specified or practical to replace them with copper conductors, utilize the appropriate materials and personnel for working with them.
 - 1. Prepare aluminum conductors at termination and tap locations as recommended by conductor manufacturer. Use oxide inhibitor listed for the purpose, and containing sharp metal particles for penetration of any remaining oxide layer.
 - 2. Each person preparing or making aluminum connections must have documented training by a qualified instructor selected or approved by the aluminum wiring manufacturer at the start of the project.
- D. Wiring at Outlets: Install conductor at each outlet with adequate slack for connection. For #10 and smaller conductors, provide at least 6 inches (150 mm) of slack.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Low-voltage control cabling.
 - 2. Control-circuit conductors.
 - 3. Identification products.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- C. EMI: Electromagnetic interference.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- F. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1. Vertical and horizontal offsets and transitions.
 - 2. Clearances for access above and to side of cable trays.
 - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - 4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wire and cable to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Insulation Fire and Smoke Ratings
 - 1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 2. Flame-Spread Index: 25 or less.
 - 3. Smoke-Developed Index: 50 or less.
- B. 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.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of each type of cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry."

2.3 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper in thermoplastic insulation complying with UL 83.

1. Type THHN-THWN or Type THHN-THWN-2, in raceway

B. Class 2 Control Circuits: Stranded copper in thermoplastic insulation complying with UL 83.

1. Type THHN-THWN or Type THHN-THWN-2, in raceway
2. Power-limited cable, concealed in building finishes
3. Power-limited tray cable, in cable tray

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.5 IDENTIFICATION PRODUCTS

A. 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:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.

4. Panduit Corp.

- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows if possible.
- E. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering room from overhead.
 - 4. Extend conduits 3 inches (75 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
3. Open-Cable Installation:
4. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
5. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
6. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).

- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables.

3.4 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with requirements in Division 16 Section "Penetration Firestopping."
- C. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- D. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test cabling for end-to-end continuity and short circuits.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding systems.
 - 2. Grounding equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features .

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. 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.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable as indicated, or if not indicated, 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. Tinned Conductors: ASTM B 33.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

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 (19 mm by 3 m) 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.
 - 1. Bury at least 24 inches (600 mm) below grade.
- C. 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 Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Listed bolted connectors or preferably (with structural engineer's approval) welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
 1. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- C. 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. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 2. 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.

3.3 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- 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. Connect grounding conductors to metal pipes using bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Use grounding conductors or braided-type bonding jumpers to electrically bypass meters, softeners, water heaters, pumps, storage tanks, regulators, valves, and such equipment if electrical continuity cannot be verified to exist otherwise (such as by visible metal bodies or casings bolted to pipes).
 2. Bond metal pipe connected to electrically powered equipment with a conductor sized not smaller than the electrical circuit's equipment grounding conductor.
 3. 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.

3.4 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."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. 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.
 4. 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.

- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. 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 and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - 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.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of 3 times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

- C. Engineered Design Documents: Where engineering design responsibilities are assigned to the Contractor, submit design documents signed and sealed by a qualified professional engineer.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates, if applicable.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with NFPA 70.

1.8 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. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.

- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
 - 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. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. 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.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, [stainless] stainless or 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.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.
- C. Steel supports exposed to weather or installed in damp locations such as crawl spaces shall be hot dip galvanized.

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 (6 mm) 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 or single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) 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 (90 kg).

- 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 Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. 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.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) 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 (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03.
- 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.

3.5 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 (0.05 mm).
- 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.
- D. All paints shall comply with AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

END OF SECTION 260529

SECTION 260533 - 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.

1.2 SUMMARY

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.
 - 1616DEFINITIONS

- 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.
- B. Sustainability Submittals:
 1. Product Data for AISD Sustainability Scorecard ALL 3MA, Low VOC: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.2 METAL CONDUITS, TUBING, AND FITTINGS

- A. 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:
 - 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. GRC: Comply with ANSI C80.1 and UL 6.
 - 1. Provide threaded fittings for RGSC except where explicit, written permission is obtained to use threadless fittings due to space constraints.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel.

- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Compression.
 - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions in which installed, and including flexible external bonding jumper.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. 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.
 - 1. Include all product data as required to confirm submitted products and those related thereto (e.g. adhesives, sealants, paints, coatings, etc.) comply with VOC threshold requirements per AISD Sustainability Scorecard ALL 3MA.

2.3 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. 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:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Kraloy.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Niedax-Kleinhuis USA, Inc.
 - 11. RACO; a Hubbell company.
 - 12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic 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. Materials and Types:
 - 1. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 - a. Fittings for RNC: Comply with NEMA TC 3; match to conduit type and material.
 - 2. RTRC (Fiberglass): Comply with UL 1684A and NEMA TC 14.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. 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:
 - 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 as required for environment unless greater protection is 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: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. 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:
 - 1. EGS/Appleton Electric.
 - 2. FSR Inc.
 - 3. Hoffman; a Pentair company.
 - 4. Hubbell Incorporated; Killark Division.
 - 5. Milbank Manufacturing Co.
 - 6. O-Z/Gedney; a brand of EGS Electrical Group.
 - 7. RACO; a Hubbell Company.

8. Thomas & Betts Corporation.
 - 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. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
 - E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
 - F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
 - G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 - I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
 - J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
 - K. Device Box Dimensions: Adequate for the device and wiring, and not less than 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) unless space is too restricted.
 - L. Gangable boxes are allowed.
 - M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type as required for environment unless greater protection is otherwise indicated; with continuous-hinge cover and flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - N. Cabinets:
 1. NEMA 250, Type as required for environment unless greater protection is otherwise indicated, 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRCRNC, Type EPC-40-PVC.
 2. Exposed on Roof: GRC, any size, and 1" and smaller EMT with raintight steel compression fittings.
 3. Concealed Conduit, Aboveground: GRC, EMT.
 4. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 6. Boxes and Enclosures, Aboveground: NEMA 250, as required for environment unless greater protection is otherwise indicated.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Severe Physical Damage: GRC. Such locations include the following and similar:
 - a. Loading dock.
 - b. Less than 8 feet above floor in corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms, less than 12" above floor.
 - d. Gymnasiums, less than 20 feet above floor.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: GRC.
 6. 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.
- C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.
- 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 compression fittings, steel (indoors or out) or cast-metal (indoors only). 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. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

- A. 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.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. 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 (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. A. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) 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 (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
- J. 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.

- K. 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.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. 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.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. For data and communications raceways, provide two (2) pull strings in each conduit 2" trade size and larger.
- T. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. 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.
- V. 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.
- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 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 (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Unconditioned Attics: 135 deg F (75 deg C) 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 (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) 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.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3.
1. Use LFMC in damp or wet locations.
 2. Use 60 to 72 inches (1525 to 1830 mm) of flexible conduit for recessed and semirecessed luminaires.
 3. Use between 12 and 36 inches (305 and 815 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- Z. 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.
- AA. 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.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Separate by at least 24" in fire rated walls.

- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. 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.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

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 indicated on drawings, or if not indicated, with sand or other approved smoothly flowing soil at least one conduit diameter deep.
2. Install backfill as indicated on drawings, or if not indicated, using sand or other approved smoothly flowing soil to at least 6" above top of conduit.
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 (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. 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 (75 mm) of concrete for a minimum of 12 inches (300 mm) 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 (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Division 2616 Section "Identification for Electrical Systems."

3.4 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."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.6 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 260533

SECTION 260544 - 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.

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:

- C. Refer to Division 07 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items. **Any requirements for or features of sleeves or seals needed for proper penetration of fire rated construction override any conflicting requirements in this Section.**

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 (0.6-mm) 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 (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

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 or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel.
 - 4. Connecting Bolts and Nuts: 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 (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.
- E. All products shall comply with AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

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.
- C. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- D. All products shall comply with AISD Sustainability Scorecard ALL 3MA requirements. Provide verified VOC content in product submittals.

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 (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 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 (50 mm) 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 galvanized steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

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 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- 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 Existing styles

- A. Where suitable existing labeling and marking systems are already established, provide new labels and marking consistent with the existing systems. Conform to existing color, pattern, material, attachment, text size and other features except as necessary to conform to any code requirement or request from the Owner to use the new features specified below instead of existing features.
- B. Equipment and piping system labeling patterns, numbering, and other serial labeling shall be rational extensions of the Owner's established patterns and be approved by Owner prior to creation.

2.2 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. 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.
- C. 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.

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.
 - 1. 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.
- C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) 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 (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) 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 (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.5 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 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.
 - 4. Utilize tape with metal tracer wire or install separate tracer wire for non-metallic buried services.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE, etc.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE, etc.
 - 4. Thickness: 12 mils (0.3 mm).
 - 5. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Comply with NFPA 70E, including "ARC-FLASH" warning signs on enclosures.

- C. 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.
 - 1. Warning label and sign shall include, but are not limited to, the following legends:
 - 2. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 - 1. Engraved legend with [black letters on white face] <Insert colors>.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.9 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 (10 mm).
- 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 (10 mm). 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 (10 mm).
- 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 (10 mm).
- E. Stenciled Legend: In non-fading, waterproof, ink or paint. Minimum letter height shall be **1 inch (25 mm)**.

2.10 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 (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 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 (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

PART 3 - EXECUTION

3.1 CONDUCTOR COLOR CODING

- A. Comply with the conductor color coding requirements in the National Electrical Code.
- B. Comply with any conductor color coding standards of the Facility.
- C. Comply with additional conductor color coding requirements of the local jurisdiction(s).

1. City of Austin, Texas:

System Type	Aø	Bø	Cø	Neu.	Gr.
120/240V 1ø	Red	Black		White	Green
120/208V 3ø	Red	Black	Blue	White	Green
120/240V 3ø "Hi Leg"	Red	Orange	Black	White	Green
277/480V 3ø	Brown	Yellow	Purple	Gray	Green

3.2 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 (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) 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 (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

- I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 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.

- K. 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.

- L. 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. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Switchboards: Both assembly and individual circuit identification shall be engraved laminated acrylic or melamine label.
 - c. Motor Control Centers: Both assembly and individual circuit identification shall be engraved laminated acrylic or melamine label.
 - d. Enclosures and electrical cabinets.
 - e. Access doors and panels for concealed electrical items.
 - f. Enclosed switches.
 - g. Enclosed circuit breakers.
 - h. Enclosed controllers.
 - i. Variable-speed controllers.

- j. Push-button stations.
- k. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy sensors.
4. Emergency shunt relays.
5. Outdoor motion sensors.
6. Standalone daylight-harvesting switching controls.
7. Lighting contactors.

- B. Related Requirements:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 SYSTEM ARCHITECTURE

1. Utilize 24 VAC Class 2 control power transformers and/or 24 VDC Class 2 power supplies for all circuits switched directly by a timeclock, photocell, motion sensor or remote low-voltage switch.
2. Utilize power relays with contact configurations and voltage, ampere and load type ratings appropriate for each load.
3. Exceptions:
 - Wallbox motion sensing switches, pole-mounted photocells, and switching devices integral to lighting fixtures rated for the application may switch the power circuit directly.
 - Timeclocks with up to four (4) poles rated for the voltage, amperage and load type may switch power circuits directly.

2.2 CONTROL EQUIPMENT SCHEDULE

- B. Basis of Design Products: Provide sensors, relays and accessory components of the type and quality scheduled below, or that are approved as equal for purposes of this project. Additional compatible accessories and related products may be required for specific spaces and explicit requirements of the project.

DEVICE	TYPE	MFGR	PIR	ULT-SONIC	MULTI
OCCUPANCY SENSOR	AREA	LEVITON	OSC20-I0W	OSC20-U0W	OSC20-MOW
OCCUPANCY SENSOR	HALL	LEVITON	OSC20-I0W	OSC20-U0W	OSC20-MOW
OCCUPANCY SENSOR	GYM	nLIGHT	nCM 6		
OCCUPANCY SENSOR	WALL	LEVITON			OSW12-MOW
OCCUPANCY SENSOR	WALL SW	LEVITON			OSSMT-GDW
OCCUPANCY SENSOR	FIXTURE	LEVITON	OSF10		
OCCUPANCY SENSOR	EXTERIOR	LEVITON	PS200-10W		
POWER PAK		LEVITON	OSP20-NDO		

- C. Full Year Timeclock: Intermatic ET90215CR with the following features:
1. 365day astronomic timing
 2. Automatic input voltage selection from 120 to 277 VAC,
 3. 4,000 events plus holiday schedules
 4. 30 Amp rated contacts
 5. 100+ hour supercapacitor maintains date and time in case of power outage
 6. USB connection for uploading, downloading and transferring of programs
 7. Ethernet capable for networking of controls to other controls and PC tools
 8. Easy to follow onscreen menus for programming to-the-minute accuracy
 9. Nonvolatile memory protects programming indefinitely
 10. Firmware upgradable infield via USB or Ethernet
 11. CAN connection supports up to 32 additional circuits or inputs externally
 12. Available in 1, 2, 4, 8, 12, and 16 circuits
 13. Internally expandable in 4circuit increments up to 16 circuits

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

- A. 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:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. NSi Industries LLC; TORK Products.
 4. Tyco Electronics; ALR Brand.
- B. General Use Photocell: Solid state, with contact configuration and voltage, amperage and load type rating required for connected relay or contactor coils, or microprocessor input; complying with UL 773A.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Fifteen second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
- C. Single-Load Photocell: Solid state, with contact configuration and voltage, amperage and load type rating required to operate connected load, complying with UL 773.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Thirty-second minimum, to prevent false operation.
 4. Lightning Arrester: Air-gap type.
 5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. 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:
1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC; TORK Products.
 9. RAB Lighting.
 10. Sensor Switch, Inc.
 11. Square D; a brand of Schneider Electric.
 12. Watt Stopper.

- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
 4. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 5. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 7. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
 8. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.

2.5 OUTDOOR MOTION SENSORS

- A. 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:
1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 6. NSi Industries LLC; TORK Products.
 7. RAB Lighting.
 8. Sensor Switch, Inc.
 9. Watt Stopper.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. PIR type, weatherproof. Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
 3. Powered from the circuit switched or from a separate 24 VAC or 24 VDC Class 2 power supply.
 4. Switch Rating:
 - Single-Load Sensor: Rated for load.
 - Low Voltage Sensor: Rated for voltage and load requirements of low voltage control system.
 5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

6. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262413 - SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Identification.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

- B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include schematic and wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Switchboard Schedules: For record, after any construction-phase changes.
- B. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for switchboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions or submit shop drawing at suitable scale to propose alternate arrangements.
- D. 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.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.
- H. Comply with NFPA 70E, including "ARC-FLASH" warning signs on enclosures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation according to NECA 407 .

1.8 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of switchboards 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.
 1. Refer to Division 2616 "Hangers and Supports" for equipment bases.

1.10 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warranty nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Front-Connected, Front-Accessible Switchboards:
 - 1. Sections front and rear aligned.
- B. Indoor Enclosures: Steel, NEMA 250, Type 1.
- C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- E. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Provide Surge Protection Device per Section 254313 and schedule on drawing.
- B. Provide manufacturer's surge protective device meeting the performance characteristic scheduled on the drawings, and otherwise installed in the manufacturer's standard manner.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489.
 - 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. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Ground-fault pickup level, time delay, and I^2t response.
 - 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

2.4 ACCESSORY COMPONENTS AND FEATURES

- A. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.5 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards 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 switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base or wall as recommended by manufacturer. Comply with requirements for concrete base specified in Division 03.
 - 1. Interior switchboards: 3-1/2-inch (90-mm) nominal thickness
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Install spare-fuse cabinet.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Acceptance Testing Preparation:
1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. 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 for Switchboards 1200 amps and larger.:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 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.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 262416 - 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. For purposes of this article and the Panelboard Schedules on the drawings, the following distinctions will be drawn between Lighting and Appliance Panels, Distribution Panels and Switchboards.
 - 1. Any panel designated as a Switchboard on the drawings or in the Panelboard Schedules, or that is rated more than 1200A shall be provided under Division-26 Section "Switchboards."
 - 2. The specification herein for Lighting and Appliance Branch-Circuit Panelboards shall apply to either of the following:
 - a. Any panel so designated on the Panel Schedule on the drawings.
 - b. Any panel designated either as a Lighting and Appliance Panel or as a Distribution Panel on the drawings that has a main buss rating not above 600 A and no branch rated in excess of 225 A.
 - 3. The specification for herein for Distribution Panelboards shall apply to either of the following:
 - a. Any panel so designated on the Panel Schedule on the drawings unless it has a main buss rating not above 600 A and no branch rated in excess of 225 A.
 - b. Any panel designated as a Lighting and Appliance Panel on Panel Schedules on the drawings that has a main buss rating above 600 A or any branch rated in excess of 225 A.

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.

- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices, where applicable.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Panelboard Schedules: For installation in panelboards, after any construction-phase changes.

1.6 CLOSEOUT SUBMITTALS

- A. Panelboard Schedules: For record, after any construction-phase changes.
- B. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.

1.8 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.
- F. Comply with NFPA 70E, including "ARC-FLASH" warning signs on panels.

1.9 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 .

1.10 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 at least the following range of conditions unless otherwise indicated:
 - a. Ambient Temperature: From minus 22 deg F (minus 30 deg C) to 104 deg F (40 deg C) indoors or 113 deg F (45 deg C) outdoors.
 - b. Altitude: Sea level to 6600 feet (2010 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Owner no fewer than seven (7) BUSINESS days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.11 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.

1.12 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warranty nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Refer to "Panelboard Schedules" and related notes on the drawings. Requirements on the drawings are more specific and override any lesser requirements herein.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Enclosures:
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, [Type 1] <Insert type>.
 - 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Finishes:

- a. Panels and Trim: 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: Galvanized steel.
4. Directory Card: Inside panelboard door, mounted in transparent card holder .
 5. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Panelboard Short-Circuit Current Rating shall be achieved by one of the following:
1. Fully rated to interrupt symmetrical short-circuit current available at terminals.
 2. Rated for series-connected system with integral (in same enclosure) overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed on the drawings or one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- 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 (914 mm) high, provide two latches, keyed alike.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
1. Exception: I-line type panelboards with bus attachment features that have been tested and demonstrated to remain fastened during faults may plug on to bus and be screw-secured to the panelboard frame.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Special Enclosure Features

1. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

1. Exception: I-line type panelboards with bus attachment features that have been tested and demonstrated to remain fastened during faults may plug on to bus and be screw-secured to the panelboard frame.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Source Limitation: Provide disconnecting and overcurrent devices recommended by the panelboard manufacturer for the application.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity (series or stand-alone as indicated in each case) 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. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 .

- 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 NECA 407 .
- B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated. Limit highest switch handle in closed position to no higher than 79" above floor.
- C. 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.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- G. Comply with NECA 1.

3.3 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."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. 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.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. 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.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

o 16PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Wall-box motion sensors.
 - 5. Isolated-ground receptacles.
 - 6. Hospital-grade receptacles.
 - 7. Snap switches and wall-box dimmers.
 - 8. Solid-state fan speed controls.
 - 9. Wall-switch and exterior occupancy sensors.
 - 10. Communications outlets.
 - 11. Pendant cord-connector devices.
 - 12. Cord and plug sets.
 - 13. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

- *16*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. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 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.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- 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.

1.7 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

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; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
- B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; 8300 (duplex).
 - b. Hubbell; HBL8310 (single), HBL8300H (duplex).
 - c. Leviton; 8310 (single), 8300 (duplex).
 - d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).
3. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper; TR8300.
 - b. Hubbell; HBL8300SG.
 - c. Leviton; 8300-SGG.
 - d. Pass & Seymour; 63H.
4. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, [**feed**] [**non-feed**]-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.

- d. Pass & Seymour; PS20AC1-PLR for 120 V.
- 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.5 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 - 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
- B. Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
 - 2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
- C. Long-Range Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 - 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).
- D. Wide-Range Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.

- b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: If not otherwise directed, assume Type 304 stainless steel with brushed finish. Submit material (stainless steel or high-impact thermoplastic), color and finish options to architect for approval.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Smooth, high-impact thermoplastic .
 5. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum or thermoplastic with lockable cover. Must be UL listed as "Raintight While in Use."

2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. 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 the 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 just 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 all devices that have been in temporary use during construction or that show signs that they 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 (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the 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. 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.

F. 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.

G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot-stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits and enclosed switches.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. . (May be supplied in the form of an internet link.)
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. (May be supplied in the form of an internet link.)
4. Coordination charts and tables and related data.

1.5 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Do not duplicate spare fuses or spare fuse cabinets specified in other Division-2616 Sections such as "Enclosed Switches and Circuit Breakers" or "Switchboards."
 2. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. 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.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.7 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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:
 1. Cooper Bussmann, Inc.
 2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
- B. Class R and J fuses shall have indicating feature which clearly indicates when the fuse has opened (blown). Indicating feature shall be completely integral with the main fuse body and shall be clearly visible from front of the fuse when installed in equipment. The indicating feature shall be fully compatible with the fuse holder geometry.
- C. Class L Fuses
 1. Interrupting rating of 200,000 amperes.
 2. Ten seconds time delay at 500% rated current
- D. Class R or J time-delay fuses
 1. Interrupting rating of 200,000 amperes.
 2. Overload element of dual element fuses shall open at a temperature less than 300 degrees F. and shall be thermally-reversible to withstand repeated cycling.
- E. Class R fuses
 1. True dual-element, time delay
 2. The means of indication shall completely isolate voltage after operation and be visible when the circuit has been de-energized.
- F. 600 volt Class J fuses shall be time delay fuses.
- G. 250 volt UL Listed Class R fuses shall be true dual-element, time delay fuses.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with hinged door and key-coded cam lock and pull.
 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Schedules on Drawings:
 - 1. Where panelboard, disconnect switch, motor controller or similar schedules on drawings indicate fuse type or class, comply with the schedules. Where not scheduled, select fuses appropriate for the duty as guided by this article.
- B. Cartridge Fuses:
 - 1. Service Entrance: Time delay fuses, Class L, Class RK1, or Class J.
 - 2. Feeders: Time delay fuses, Class L, Class RK1, Class RK5, or Class J.
 - 3. Motor Branch Circuits: Time delay fuses, Class RK1, Class RK5, or Class J.
 - 4. Other Branch Circuits: Time delay fuses, Class RK1, Class RK5, or Class J.
 - 5. Control Circuits: Class CC, time delay, unless fast acting fuse is recommended by control system manufacturer.
- C. Motor Circuit fuses.
 - 1. General. It is the intent of these specifications that each individual motor branch circuit be protected by the minimum fuse ratings which will permit satisfactory operation of the motor without nuisance openings. Maintaining minimum fuse ratings provides maximum protection to the circuit components and reduces damage during fault conditions. Whenever possible, fuses shall be rated as indicated on drawings. If motor characteristics are such that these ratings are not adequate, fuse ratings shall be increased the minimum necessary to permit satisfactory operation of the motor, but in no case shall the maximum fuse ratings exceed those permitted by the National Electrical Code.
 - 2. Individual motor branch short-circuit and ground fault protection when NEMA motor controllers are used in the circuit:
 - a. Motors 440 to 600 volts: Fuses for individual motor branch-circuit protection shall be 600 volt, Class RK1 dual-element indicating fuses.
 - b. Motors 240 volts and below: Fuses for individual motor branch-circuit protection shall be 250 volt, Class RK5 dual-element fuses.

3. Individual motor branch short-circuit and ground fault protection when IEC motor controllers are used in the circuit and IEC Type 2 coordination, "no damage protection" is required. IEC controllers require maximum current limitation. Most manufacturers of IEC controllers have published tables specifying the fuse classes and maximum fuse ratings which will offer Type 2 protection for their controllers. These ratings shall not be exceeded. Fuses shall be Class J.
 - a. Class J fuses for Type 2 coordination shall be time-delay indicating fuses.
4. Fuses in motor control centers (MCC) containing NEMA motor controllers. Provide time-delay Class RK1 or RK5 fuses in those MCC which will accept Class R fuses. Where MCC manufacturers have standardized on Class J fuses, provide time-delay Class J fuses.

D. Fuses Protecting Molded Case Circuit Breaker Panelboards

1. Fully-rated panelboards: Molded case circuit breaker panelboards having a short-circuit rating equal to or exceeding the available short-circuit current at the point where the panelboard is applied shall be protected with indicating Class RK1 or Class RK5 fuses.
2. Series-rated panelboards: Molded case circuit breaker panelboards having short-circuit ratings less than the available short-circuit current at the point where the panelboard is applied, shall be protected by Class and maximum fuse ratings listed by the panelboard manufacturer for UL series ratings. Whenever possible they shall be time-delay Class RK1 indicating fuses or Class J indicating fuses. Where manufacturers indicate only Class "T" fuses, the fuses shall be as specified by the panelboard manufacturer.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. . (May be supplied in the form of an internet link.)

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. . (May be supplied in the form of an internet link.)

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions or submit shop drawing for approval of any deviation or re-arrangement.
- 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 NFPA 70.
- E. Comply with NFPA 70E, including "ARC-FLASH" warning signs on enclosures.

1.7 PROJECT CONDITIONS

- A. Rate equipment for continuous operation under at least the following range of conditions unless otherwise indicated:
 - 1. Ambient Temperature: From minus 22 deg F (minus 30 deg C) to 104 deg F (40 deg C) indoors or 113 deg F (45 deg C) outdoors.
 - 2. Altitude: Sea level to 6600 feet (2010 m).
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect, Construction Manager and/or Owner no fewer than two (2) <Insert number> days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without written permission from Architect, Construction Manager and/or Owner.
 - 3. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

- A. 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:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. For fusible switches, provide clips or bolt pads to accommodate specified or indicated fuses.
- C. Provide switches with features, properties and ratings indicated on the drawings. If not explicitly noted or scheduled, match voltage, amperes, poles, wires to properties of the circuit and load served, and provide enclosure suitable for the environment.
- D. Fusible switches are required except where non-fusible switches are explicitly permitted. (Even if the upstream breaker trip rating is equal to or smaller than the switch rating, and even if the breaker fault rating is adequate for the fault at its location, it does not necessarily protect a non-fusible switch in a high-fault event. Further, changing the fuse size at a disconnect switch is typically easier than changing out a circuit breaker if a circuit's overcurrent rating exceeds the maximum overcurrent protection rating of the original or future replacement equipment.)
- E. Type HD, Heavy Duty, Single Throw, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Provide if circuit served requires a neutral conductor. Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provide for rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Provide quantity required for application.
 - 5. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 6. Service-Rated Switches: Labeled for use as service equipment.

2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location. Provide enclosure type indicated on the drawing, or if not indicated, provide suitable enclosure under guidance of the following:
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen & Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Cooling Tower Areas: NEMA 250, Type 4X, stainless steel.
 - 5. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 6. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Provide enclosed switches and circuit breakers with features and ratings indicated on the drawings and as required to perform the indicated functions. Where features and ratings are not enumerated, provide devices with electrical ratings, poles and wires to match indicated circuit ratings and features. Provide equipment enclosures rated for the environment.
- B. Any switching device applied downstream of a variable frequency drive shall be equipped with an auxiliary contact wired to shut down the VFD just before the switch contacts are opened.
- C. Any switching or protective device applied downstream of a variable frequency drive shall be suitable for operation at any frequency, voltage and current at which the drive may operate.

3.3 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage magnetic.
- B. Related Section:
 - 1. Division 26 Section "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

1.9 PROJECT CONDITIONS

- A. Rate equipment for continuous operation under at least the following range of conditions unless otherwise indicated:
 - 1. Ambient Temperature: From minus 22 deg F (minus 30 deg C) to 104 deg F (40 deg C) indoors or 113 deg F (45 deg C) outdoors.
 - 2. Altitude: Sea level to 6600 feet (2010 m).

1.10 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Magnetic Controllers: Full voltage, across the line, electrically held.

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Configuration: Non-reversing.
 3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 6. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 7. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 8. External overload reset push button.
- C. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 2. Fusible Disconnecting Means:

- a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
- b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 1. Dry and Clean Indoor Locations: Type 1

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.
 - a. Pilot Lights: LED types; verify colors with Owner.
 - b. Selector Switches: Rotary type.
- B. Auxiliary contacts: 2 NO, 2 NC or more if specified on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."

- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation.
 - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer and Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

3.7 PROTECTION

- A. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 264313 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes field-mounted SPD for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Sections:
 - 1. Division 26 Section "Switchboards" for factory-installed SPD.
 - 2. Division 26 Section "Panelboards" for factory-installed SPD.
 - 3. Division 26 Section "Wiring Devices" for devices with integral SPD.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protective Device(s), both singular and plural.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For SPD to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

- C. Comply with NEMA LS 1.
- D. Comply with UL 1449.
- E. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - B. Notify Owner no fewer than two days in advance of proposed electrical service interruptions.
 - 1. Do not proceed with interruption of electrical service without Owner's written permission.
- C. Service Conditions: Rate SPD for continuous operation under the following conditions unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.9 COORDINATION

- A. Coordinate location of field-mounted SPD to allow adequate clearances for maintenance.

1.10 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warranty nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge protective devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICE SCHEDULE

- A. Comply with all ratings and requirements in the Surge Protective Device (SPD) Schedule on the drawings.
- B. Any deviation from the scheduled requirements must be noted clearly on the submittal and be approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install SPD at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install SPD for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multi-pole circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 DEMONSTRATION

- A. Train Owner's maintenance personnel to maintain SPD.

END OF SECTION 264313

SECTION 265600 - EXTERIOR LIGHTING

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. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. HID: High-intensity discharge.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. Pole: Luminaire support structure, including tower used for large area illumination.
- G. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.
- C. Ice Load: Applied as stated in AASHTO LTS-4-M Ice Load Map.

- D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M. Use windspeed data for the project site and importance criteria obtained from the Architect, Owner and/or local code authorities.

1.5 ACTION SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
6. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by one of the following:
 - a. Manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.
7. Photoelectric relays.
8. Ballasts, including energy-efficiency data.
9. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
10. Materials, dimensions, and finishes of poles.
11. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
12. Anchor bolts for poles.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.6 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.
- B. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.
- 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 IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch (6 mm) deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.10 WARRANTY

- A. General Warranty: The contractor shall warrant all materials and workmanship for one year following the date of substantial completion. Neither this warranty nor any special warranty specified in this Article shall deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents or local laws, and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain,

perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURE SCHEDULE

- A. Refer to Lighting Fixture Schedule and related notes on the Drawings.
- B. Features explicitly specified in the Lighting Fixture Schedule shall be considered more specific and thus override the more general requirements in this Specification Section.

2.2 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.3 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
 1. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
 2. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during

relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by Architect from manufacturer's standard catalog of colors.
- N. Factory-Applied Finish for Aluminum luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast characteristics:
 - a. "USES ONLY" and include specific lamp type.

- b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
- e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- f. CCT and CRI for all luminaires.

2.4 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens or aperture in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.5 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Each pole for lighting fixture support shall be selected for the Effective Projected Area (EPA) of the service platform, arms and fixtures to be supported, and of the pole itself. Weight, center of gravity and any stresses from lowering of the fixtures or hinging of the pole shall be accommodated.
- B. Pole manufacturer shall supply complete loading information and pole base information for design of the structural support base, footing, piling or such. Poles shall be equipped with hand holes, grounding lugs, bases, bolt covers, anchor bolts, setting templates and such accessories as are required for complete readiness of the pole for use.
- C. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
- D. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- E. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- F. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- G. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws. Provide on all, except wood poles.
- H. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.6 LIGHT POLE AND ACCESSORY FEATURES

- A. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- B. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch (76-by-127-mm) handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- C. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- D. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- E. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- F. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

3.4 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

- a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
 - b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
 - c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
 - d. IESNA LM-64, "Photometric Measurements of Parking Areas."
 - e. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600

SECTION 267100 - ROOF-RELATED ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. These specifications include all labor, materials, equipment and related items required to disconnect and re-connect all equipment, electrical relocations as required to accommodate proper roof flashings, and to complete the Work within the intent of the Drawings and Specifications, whether or not specifically mentioned or shown therein. For this reason, the Contractor shall visit the site and familiarize himself with the areas in which Work is to be done before submitting his bid.
- B. Electrical Work necessary for this project includes but is not limited to the resetting of conduit for building and HVAC units, removal of unused conduits, the disconnecting and reconnecting of electrical supply to HVAC and other mechanical units scheduled to receive new or modified curbs, etc., all in accordance with one another and necessary to achieve proper flashing heights and details. Where required for compliance with applicable codes and local amendments, Contractor shall provide disconnect switches and weatherproof, GFCI protected maintenance receptacles per NEC on separately mounted galvanized steel support racks for roof mounted HVAC equipment. Where required for compliance with applicable codes and local amendments, provide disconnect switches and weatherproof, GFCI-protected racks for roof-mounted HVAC equipment.
- C. Modifications to existing communications cables (fiber optic and copper) will be accomplished by the Owner. No disruption may occur in these lines without minimum 72-hour written notice to the Architect and Owner and granting of approval.
- D. Set all sleeves and cut and patch all miscellaneous holes necessary for the convenient and proper installation of the Work as applicable. Required holes through existing masonry construction with an area of less than 35 square inches shall be considered miscellaneous holes.
- E. Any Work installed without regard to the Work of other crafts which must, in the opinion of the Architect, be moved to permit the installation of other Work, shall be moved and replaced as part of this Work without extra charge.
- F. Removed conduits shall have all associated wire and cables taken back to associated circuit breaker, fuse box or other such junction so as to allow for complete removal with no exceptions taken with regards to safety or code requirements.
- G. All Work shall be accomplished within the scheduled times indicated in Section 237100, Article 1.08.
- H. Contractor shall follow and be responsible for all necessary contract closeouts, hoisting, caulking and sealants, hangers and related items pertaining to this contract.

1.2 RELATED REQUIREMENTS

General Conditions, Supplementary General Conditions, Forms, Specification Sections found in Division 01 through Division 16, and all Drawings apply to Work specified in this Section.

1.3 RELATED SECTIONS

- A. Section 077200 - Roof Accessories
- B. Section 237100 - Roof-Related Mechanical Provisions

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Where mechanical items must be disconnected and re-connected as necessary by the re-roofing of the specified areas at these facilities, all wires, conduits, panels, motor starters, raceways, switches, stations, etc., shall be replaced or renewed to match existing if damaged, cut or needing extension, etc. All materials shall meet the minimum standards of the National Electrical Code; latest edition adopted by the City of Austin.
- B. Prior to installation, coordinate all necessary Work with associated trades and Owner.

PART 3 - EXECUTION

3.1 PERFORMANCE

Work shall be performed by a qualified electrical contractor, licensed to do Work in the City of Austin, Travis County and the State of Texas. All workmanship shall be in compliance with all code requirements and shall be inspected as required by all governing authorities. All Work shall meet the minimum standards of the latest edition of the National Electrical Code and locally adopted amendments.

3.2 SCHEDULING

- A. All Work necessary shall be in compliance with Owner's requests for proper scheduling so that the least amount of interference with daily production and school duties is required.
- B. Work requiring the disconnection or re-connection of any electrical or communication line(s) must be coordinated through the Architect with a minimum of 72-hours written notice.
- C. All electrical disconnects shall be accomplished during periods when the building will not be disrupted by power outages.

END OF SECTION 267100