







IDEA Public Schools
San Benito HVAC/Controls
CSP# 16-SBHVAC-1226

Due on November 19, 2026
2:00 PM

1126 S. Commerce ST.
Harlingen, Tx 78550
O: (956) 230-3435
F: (956) 720-0830

Texas Registered Engineering Firm F-15998

TABLE OF CONTENTS

MEP SPECIFICATIONS FOR IDEA PUBLIC SCHOOLS, SAN BENITO
HVAC/CONTROLS CSP# 16-SBHVAC-1226, SAN BENITO, TX

November 3, 2026

DIVISION 0: PROCUREMENT AND CONTRACTING REQUIREMENTS

000100 Request for Competitive Sealed Proposal
000141 Contractor's Qualifications Statement (AIA A305)
000200 Instructions to Bidders: AIA - 701
000210 Supplementary Instructions to Bidders
Proposal Evaluation Matrix
Non-Collusive Statement
Certificate of Residency
Criminal History Background Searches
Felony Conviction Notification
Conflict of Interest (CIQ)
Compliance with SB 253
Compliance with HB 89
W-9 Form
000400 Competitive Sealed Proposal Form
000500 AIA 101-2017 Standard Form of Agreement Between Owner and Contractor
000520 Supplementary Conditions AIA A101-2017
000600 AIA 201- 2017 General Conditions of the Contract for Construction
000605 Supplementary Conditions AIA A201-2017
000610 Bid Bond: AIA - 310
000620 Performance and Payment Bonds: AIA – 312
000820 Schedule of Values
000860 Certificate of Project Compliance

DIVISION 1: GENERAL REQUIREMENTS

011000 Summary of Work
012100 Allowances
012900 Payment Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014200 References
016000 Product Requirements

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017300 Execution
017320 Selective Demolition
017400 Guarantees
017700 Closeout Procedures
017823 Operation and Maintenance Data
019113 General Commissioning Requirements

DIVISION 3: CONCRETE
033000 Cast-In-Place Concrete (Limited Applications)

DIVISION 9: PAINTING
099000 Painting

DIVISION 23: MECHANICAL
230010 Summary of Mechanical Work
230513 Common Motor Requirements for HVAC Equipment
230517 Sleeves and Sleeve Seals for HVAC Piping
230518 Escutcheons for HVAC Piping
230529 Hangers and Supports for HVAC Piping and Equipment
230548.13 Vibration Controls for HVAC
230553 Identification for HVAC Piping and Equipment
230593 Testing, Adjusting, and Balancing for HVAC
230713 Duct Insulation
230719 HVAC Piping Insulation
230800 Commissioning of HVAC
230900 Instrumentation and Controls
230993 Sequence of Operations for HVAC Controls
232300 Refrigerant Piping
232923 Variable Frequency Motor Controllers
233113 Metal Ducts
233300 Air Duct Accessories
236200 Packaged Compressor and Condenser Units
237313 Modular Indoor Central-Station Air-Handling Units

DIVISION 26: ELECTRICAL
260010 Summary of Electrical Work
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260553 Identification for Electrical Systems
260800 Commissioning of Electrical Systems
267210 Fire Alarm System

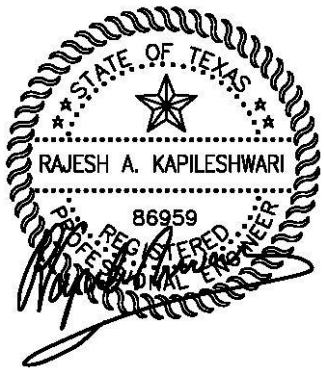
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262816 Enclosed Switches and Circuit Breakers
269750 Voice and Data Communication Cable Line Equipment

DRAWINGS:

COVER COVER SHEET
ME1.01 GENERAL NOTES, SYMBOLS, AND LEGEND
ME2.01 MECHANICAL & ELECTRICAL DEMOLITION PLANS – BUILDING B
ME2.02 MECHANICAL & ELECTRICAL DEMOLITION PLANS – BUILDING C
ME2.03 MECHANICAL & ELECTRICAL DEMOLITION PLANS – BUILDING E
ME3.01 MECHANICAL & ELECTRICAL RENOVATION PLANS – BUILDING B
ME3.02 MECHANICAL & ELECTRICAL RENOVATION PLANS – BUILDING C
ME3.03 MECHANICAL & ELECTRICAL RENOVATION PLANS – BUILDING E
ME4.01 MECHANICAL & ELECTRICAL SCHEDULES
ME5.01 MECHANICAL & ELECTRICAL DETAILS



November 3, 2026

DATE: **November 3, 2026**

PROPOSAL: & PROJECT NO:	**CSP# 16-SBHVAC-1226 San Benito HVAC/Controls**
DUE DATE, TIME &: PLACE	**Thursday, November 19, 2026 @ 2:00 PM** IDEA Public Schools Headquarters Attn: Solicitation Team 2115 W Pike Blvd, Weslaco, TX 78596
ENGINEER:	Ethos Engineering 1126 South Commerce St. Harlingen, TX 78550

IDEA Public Schools and affiliated entities (IDEA) are accepting proposals from qualified and experienced firms for **"CSP# 16-SBHVAC-1226 San Benito/Controls"** project, in accordance with instructions, specifications, terms, and conditions contained in this solicitation. A copy of the solicitation can be found on the IDEA website:
Bid Opportunities & RFPs - IDEA Public Schools, Public Purchase or through Tyler Munis Vendor Self Service at https://selfservicetx.ideapublicschools.org/MSS/Vendors/.

Sealed proposals will be submitted to **IDEA Public Schools Headquarters, Attn: Solicitation Team, 2115 W Pike Blvd, Weslaco, TX 78596 on or before 2:00 PM C.S.T. on Thursday, November 19, 2026.** Proposals will be read aloud immediately after bid due date and time via virtual platform **at 2:15 PM.**

Microsoft Teams meeting
Join on your computer, mobile app or room device
https://teams.microsoft.com/meet/2947332947968940?p=qbXCp2wJ2PZ1th18QZ
Meeting ID: 294 733 294 796 894 0
Passcode: Rm7Y5fM9
Download Teams | Join on the web

Proposals received after this time will not be accepted and returned unopened. For questions related to this solicitation, contact the IDEA Procurement & Contract Services Solicitation Team via email at facprocurement@ideapublicschools.org.

Scope of Work: Scope of Work: Provide labor, material, and equipment related to mechanical upgrades including but is not limited to, the replacement of DX air-handling units, air-cooled condensing units, related refrigerant piping, valves, insulation, electrical and controls upgrades. Provide controls replacements as indicated.

Proposals must be on a lump sum basis including General Contract and Mechanical work. Bid security in the amount of 5% of the largest possible total of proposals submitted must accompany each proposal in accordance with the Instructions to Bidders. Performance and payment bonds for 100% of the contract value will be required upon issuance of contract.

Proposal envelopes shall be plainly marked, **"CSP#16-SBHVAC-1226 San Benito/Controls".** Please submit one (1) hard copy, any Proposal received later than the specified time, whether delivered in person or mailed, will be disqualified. Faxed or emailed Bids are not acceptable. No

Proposal may be withdrawn for a period of 30 days after Proposal due date without the consent of the Owner. Bids received after Proposal deadline will be returned unopened to Bidder. Personal delivery of Proposal is recommended. The Owner reserves the right to reject any and/or all Bids or accept any Proposal or portion thereof most advantageous to the Owner after the ranking and evaluation.

Pre-proposal virtual conference meeting has been scheduled for **Friday, November 13, 2026, at 10:00 AM via virtual platform.**

Microsoft Teams meeting
Join on your computer, mobile app or room device

Microsoft Teams meeting
https://teams.microsoft.com/meet/218797031325661?p=axocvMr3zoJdzjvbpW
Meeting ID: 218 797 031 325 661
Passcode: 7LE2oL6j
Download Teams | Join on the web

Sites visits have been scheduled for **Friday, November 13, 2026, at 10:30 AM** at **IDEA San Benito is 2151 Russell Ln, San Benito, TX 78586**

Refer to construction documents for more information including video conference instructions for both the pre-construction and bid opening meetings.

Each Bidder will be held to have studied the Plans and Specifications, to have visited all sites affecting the proposed work, to have satisfied themselves regarding all existing conditions and measurements, and to have included in their Proposal an amount sufficient to cover all work. To schedule additional site visits, please contact the Owner.

All firms submitting Bids for this project are required to meet all qualification requirements as established in these Bid documents.

Should any Bidder find discrepancies between the Plans and Specifications, or be in doubt as to their exact meaning, they should notify the Engineer at once. The Engineer may, but is not required to, issue an addendum clarifying same. Neither the Owner nor the Engineer will be responsible for oral instructions or for misinterpretations of Plans and Specifications. Additional information including addenda will be issued to known plan holders including construction plan rooms.

END OF SECTION 000100

AIA® Document A305® – 2020

Contractor's Qualification Statement

THE PARTIES SHOULD EXECUTE A SEPARATE CONFIDENTIALITY AGREEMENT IF THEY INTEND FOR ANY OF THE INFORMATION IN THIS A305-2020 TO BE HELD CONFIDENTIAL.

SUBMITTED BY:
(Organization name and address.)

SUBMITTED TO:
(Organization name and address.)

TYPE OF WORK TYPICALLY PERFORMED
(Indicate the type of work your organization typically performs, such as general contracting, construction manager as constructor services, HVAC contracting, electrical contracting, plumbing contracting, or other.)

THIS CONTRACTOR'S QUALIFICATION STATEMENT INCLUDES THE FOLLOWING:
(Check all that apply.)

[ ] Exhibit A – General Information
[ ] Exhibit B – Financial and Performance Information
[ ] Exhibit C – Project-Specific Information
[ ] Exhibit D – Past Project Experience
[ ] Exhibit E – Past Project Experience (Continued)

CONTRACTOR CERTIFICATION
The undersigned certifies under oath that the information provided in this Contractor's Qualification Statement is true and sufficiently complete so as not to be misleading.

{{@signerTag}}
CONTRACTOR'S Authorized Representative *(Signature)*

(Printed name and title)

Date

NOTARY
State of:
County of:
Signed and sworn to before me this day of

Notary Signature
My commission expires:

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AIA® Document A305® – 2020 Exhibit A

General Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by and dated the day of in the year
(In words, indicate day, month and year.)

§ A.1 ORGANIZATION

§ A.1.1 Name and Location

§ A.1.1.1 Identify the full legal name of your organization.

§ A.1.1.2 List all other names under which your organization currently does business and, for each name, identify jurisdictions in which it is registered to do business under that trade name.

§ A.1.1.3 List all prior names under which your organization has operated and, for each name, indicate the date range and jurisdiction in which it was used.

§ A.1.1.4 Identify the address of your organization's principal place of business and list all office locations out of which your organization conducts business. If your organization has multiple offices, you may attach an exhibit or refer to a website.

§ A.1.2 Legal Status

§ A.1.2.1 Identify the legal status under which your organization does business, such as sole proprietorship, partnership, corporation, limited liability corporation, joint venture, or other.

.1 If your organization is a corporation, identify the state in which it is incorporated, the date of incorporation, and its four highest-ranking corporate officers and their titles, as applicable.

.2 If your organization is a partnership, identify its partners and its date of organization.

.3 If your organization is individually owned, identify its owner and date of

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organization.

.4 If the form of your organization is other than those listed above, describe it and identify its individual leaders:

§ A.1.2.2 Does your organization own, in whole or in part, any other construction-related businesses? If so, identify and describe those businesses and specify percentage of ownership.

§ A.1.3 Other Information

§ A.1.3.1 How many years has your organization been in business?

§ A.1.3.2 How many full-time employees work for your organization?

§ A.1.3.3 List your North American Industry Classification System (NAICS) codes and titles. Specify which is your primary NAICS code.

§ A.1.3.4 Indicate whether your organization is certified as a governmentally recognized special business class, such as a minority business enterprise, woman business enterprise, service disabled veteran owned small business, woman owned small business, small business in a HUBZone, or a small disadvantaged business in the 8(a) Business Development Program. For each, identify the certifying authority and indicate jurisdictions to which such certification applies.

§ A.2 EXPERIENCE

§ A.2.1 Complete Exhibit D to describe up to four projects, either completed or in progress, that are representative of your organization's experience and capabilities.

§ A.2.2 State your organization's total dollar value of work currently under contract.

§ A.2.3 Of the amount stated in Section A.2.2, state the dollar value of work that remains to be completed:

§ A.2.4 State your organization's average annual dollar value of construction work performed during the last five years.

§ A.3 CAPABILITIES

§ A.3.1 List the categories of work that your organization typically self-performs.

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§ A.3.2 Identify qualities, accreditations, services, skills, or personnel that you believe differentiate your organization from others.

§ A.3.3 Does your organization provide design collaboration or pre-construction services? If so, describe those services.

§ A.3.4 Does your organization use building information modeling (BIM)? If so, describe how your organization uses BIM and identify BIM software that your organization regularly uses.

§ A.3.5 Does your organization use a project management information system? If so, identify that system.

§ A.4 REFERENCES

§ A.4.1 Identify three client references:
(Insert name, organization, and contact information)

§ A.4.2 Identify three architect references:
(Insert name, organization, and contact information)

§ A.4.3 Identify one bank reference:
(Insert name, organization, and contact information)

§ A.4.4 Identify three subcontractor or other trade references:
(Insert name, organization, and contact information)

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AIA® Document A305® – 2020 Exhibit B

Financial and Performance Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by and dated the day of in the year
(In words, indicate day, month and year.)

§ B.1 FINANCIAL

§ B.1.1 Federal tax identification number:

§ B.1.2 Attach financial statements for the last three years prepared in accordance with Generally Accepted Accounting Principles, including your organization's latest balance sheet and income statement. Also, indicate the name and contact information of the firm that prepared each financial statement.

§ B.1.3 Has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, been the subject of any bankruptcy proceeding within the last ten years?

§ B.1.4 Identify your organization's preferred credit rating agency and identification information.
(Identify rating agency, such as Dun and Bradstreet or Equifax, and insert your organization's identification number or other method of searching your organization's credit rating with such agency.)

§ B.2 DISPUTES AND DISCIPLINARY ACTIONS

§ B.2.1 Are there any pending or outstanding judgments, arbitration proceedings, bond claims, or lawsuits against your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, or any of the individuals listed in Exhibit A, Section 1.2, in which the amount in dispute is more than $75,000?
(If the answer is yes, provide an explanation.)

§ B.2.2 In the last five years has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management:
(If the answer to any of the questions below is yes, provide an explanation.)

.1 failed to complete work awarded to it?

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.2 been terminated for any reason except for an owners' convenience?

.3 had any judgments, settlements, or awards pertaining to a construction project in which your organization was responsible for more than $75,000?

.4 filed any lawsuits or requested arbitration regarding a construction project?

§ B.2.3 In the last five years, has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management; or any of the individuals listed in Exhibit A Section 1.2:
(If the answer to any of the questions below is yes, provide an explanation.)

.1 been convicted of, or indicted for, a business-related crime?

.2 had any business or professional license subjected to disciplinary action?

.3 been penalized or fined by a state or federal environmental agency?

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AIA® Document A305® – 2020 Exhibit C

Project Specific Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by and dated the day of in the year
(In words, indicate day, month and year.)

PROJECT:
(Name and location or address.)

CONTRACTOR'S PROJECT OFFICE:
(Identify the office out of which the contractor proposes to perform the work for the Project.)

TYPE OF WORK SOUGHT
(Indicate the type of work you are seeking for this Project, such as general contracting, construction manager as constructor, design-build, HVAC subcontracting, electrical subcontracting, plumbing subcontracting, etc.)

CONFLICT OF INTEREST
Describe any conflict of interest your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, or any of the individuals listed in Exhibit A Section 1.2, may have regarding this Project.

§ C.1 PERFORMANCE OF THE WORK

§ C.1.1 When was the Contractor's Project Office established?

§ C.1.2 How many full-time field and office staff are respectively employed at the Contractor's Project Office?

§ C.1.3 List the business license and contractor license or registration numbers for the Contractor's Project Office that pertain to the Project.

§ C.1.4 Identify key personnel from your organization who will be meaningfully involved with work on this Project and indicate (1) their position on the Project team, (2) their

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office location, (3) their expertise and experience, and (4) projects similar to the Project on which they have worked.

§ C.1.5 Identify portions of work that you intend to self-perform on this Project.

§ C.1.6 To the extent known, list the subcontractors you intend to use for major portions of work on the Project.

§ C.2 EXPERIENCE RELATED TO THE PROJECT

§ C.2.1 Complete Exhibit D to describe up to four projects performed by the Contractor's Project Office, either completed or in progress, that are relevant to this Project, such as projects in a similar geographic area or of similar project type. If you have already completed Exhibit D, but want to provide further examples of projects that are relevant to this Project, you may complete Exhibit E.

§ C.2.2 State the total dollar value of work currently under contract at the Contractor's Project Office:

§ C.2.3 Of the amount stated in Section C.2.2, state the dollar value of work that remains to be completed:

§ C.2.4 State the average annual dollar value of construction work performed by the Contractor's Project Office during the last five years.

§ C.2.5 List the total number of projects the Contractor's Project Office has completed in the last five years and state the dollar value of the largest contract the Contractor's Project Office has completed during that time.

§ C.3 SAFETY PROGRAM AND RECORD

§ C.3.1 Does the Contractor's Project Office have a written safety program?

§ C.3.2 List all safety-related citations and penalties the Contractor's Project Office has received in the last three years.

§ C.3.3 Attach the Contractor's Project Office's OSHA 300a Summary of Work-Related Injuries and Illnesses form for the last three years.

§ C.3.4 Attach a copy of your insurance agent's verification letter for your organization's current workers' compensation experience modification rate and rates for the last three years.

§ C.4 INSURANCE

§ C.4.1 Attach current certificates of insurance for your commercial general liability policy, umbrella insurance policy,

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and professional liability insurance policy, if any. Identify deductibles or self-insured retentions for your commercial general liability policy.

§ C.4.2 If requested, will your organization be able to provide property insurance for the Project written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis?

§ C.4.3 Does your commercial general liability policy contain any exclusions or restrictions of coverage that are prohibited in AIA Document A101-2017, Exhibit A, Insurance A.3.2.2.2? If so, identify.

§ C.5 SURETY

§ C.5.1 If requested, will your organization be able to provide a performance and payment bond for this Project?

§ C.5.2 Surety company name:

§ C.5.3 Surety agent name and contact information:

§ C.5.4 Total bonding capacity:

§ C.5.5 Available bonding capacity as of the date of this qualification statement:

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AIA® Document A305™ – 2020 Exhibit D

Contractor's Past Project Experience

	1	2	3	4
PROJECT NAME				
PROJECT LOCATION				
PROJECT TYPE				
OWNER				
ARCHITECT				
CONTRACTOR'S PROJECT EXECUTIVE				
KEY PERSONNEL (include titles)				
PROJECT DETAILS	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work
PROJECT DELIVERY METHOD	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:
SUSTAINABILITY CERTIFICATIONS				

Sample

Init.

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AIA® Document A305™ – 2020 Exhibit E

Contractor's Past Project Experience, Continued

	1	2	3	4
PROJECT NAME				
PROJECT LOCATION				
PROJECT TYPE				
OWNER				
ARCHITECT				
CONTRACTOR'S PROJECT EXECUTIVE				
KEY PERSONNEL (include titles)				
PROJECT DETAILS	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work
PROJECT DELIVERY METHOD	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:
SUSTAINABILITY CERTIFICATIONS				

Sample

Init.

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DRAFT

AIA® Document A701™ – 1997

Instructions to Bidders

for the following PROJECT:
(Name and location or address)
« »
« »

THE OWNER:
(Name, legal status and address)
« »« »
« »

THE ARCHITECT:
(Name, legal status and address)
« »« »
« »

TABLE OF ARTICLES

1 DEFINITIONS

2 BIDDER'S REPRESENTATIONS

3 BIDDING DOCUMENTS

4 BIDDING PROCEDURES

5 CONSIDERATION OF BIDS

6 POST-BID INFORMATION

7 PERFORMANCE BOND AND PAYMENT BOND

8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

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

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

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ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 The Bidder by making a Bid represents that:

§ 2.1.1 The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.

§ 2.1.2 The Bid is made in compliance with the Bidding Documents.

§ 2.1.3 The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.

§ 2.1.4 The Bid is based upon the materials, equipment and systems required by the Bidding Documents without exception.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 COPIES

§ 3.1.1 Bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid in the number and for the deposit sum, if any, stated therein. The deposit will be refunded to Bidders who submit a bona fide Bid and return the Bidding Documents in good condition within ten days after receipt of Bids. The cost of replacement of missing or damaged documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the Bidding Documents and the Bidder's deposit will be refunded.

§ 3.1.2 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instructions to bidders.

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§ 3.1.3 Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

§ 3.1.4 The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

§ 3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

§ 3.2.1 The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies or ambiguities discovered.

§ 3.2.2 Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.

§ 3.2.3 Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

§ 3.3 SUBSTITUTIONS

§ 3.3.1 The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

§ 3.3.2 No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.3 If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

§ 3.3.4 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 ADDENDA

§ 3.4.1 Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.

§ 3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 PREPARATION OF BIDS

§ 4.1.1 Bids shall be submitted on the forms included with the Bidding Documents.

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§ 4.1.2 All blanks on the bid form shall be legibly executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.

§ 4.1.4 Interlineations, alterations and erasures must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall make no additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the Work. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

§ 4.2 BID SECURITY

§ 4.2.1 Each Bid shall be accompanied by a bid security in the form and amount required if so stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the Owner in the event the Owner fails to comply with Section 6.2.

§ 4.2.2 If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, unless otherwise provided in the Bidding Documents, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.

§ 4.2.3 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

§ 4.3 SUBMISSION OF BIDS

§ 4.3.1 All copies of the Bid, the bid security, if any, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.2 Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

§ 4.3.3 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.4 Oral, telephonic, telegraphic, facsimile or other electronically transmitted bids will not be considered.

§ 4.4 MODIFICATION OR WITHDRAWAL OF BID

§ 4.4.1 A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

§ 4.4.2 Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-

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stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worded as not to reveal the amount of the original Bid.

§ 4.4.3 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

§ 4.4.4 Bid security, if required, shall be in an amount sufficient for the Bid as resubmitted.

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 OPENING OF BIDS

At the discretion of the Owner, if stipulated in the Advertisement or Invitation to Bid, the properly identified Bids received on time will be publicly opened and will be read aloud. An abstract of the Bids may be made available to Bidders.

§ 5.2 REJECTION OF BIDS

The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.

§ 5.3 ACCEPTANCE OF BID (AWARD)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest qualified Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's own best interests.

§ 5.3.2 The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 CONTRACTOR'S QUALIFICATION STATEMENT

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request, a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

§ 6.2 OWNER'S FINANCIAL CAPABILITY

The Owner shall, at the request of the Bidder to whom award of a Contract is under consideration and no later than seven days prior to the expiration of the time for withdrawal of Bids, furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Unless such reasonable evidence is furnished, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 SUBMITTALS

§ 6.3.1 The Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, after notification of selection for the award of a Contract, furnish to the Owner through the Architect in writing:

- **.1** a designation of the Work to be performed with the Bidder's own forces;
- **.2** names of the manufacturers, products, and the suppliers of principal items or systems of materials and equipment proposed for the Work; and
- **.3** names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder in writing if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, (1) withdraw the Bid or (2) submit an acceptable substitute person or entity with an adjustment in the Base Bid or

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Alternate Bid to cover the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 BOND REQUIREMENTS

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

§ 7.2 TIME OF DELIVERY AND FORM OF BONDS

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

ARTICLE 8 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment Is a Stipulated Sum.

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The following supplements contain changes and additions to the Instructions to Bidders, AIA Document A701, 1997 Edition. The portions of the Instructions to Bidders not modified, supplemented or deleted by these Supplementary Instructions to Bidders shall remain in effect. As appropriate, for purposes of this Request for Competitive Sealed Bids, the term “Proposal” shall mean “Bid”, the term “Offeror” shall mean “Bidder”, and the term “Architect” shall mean “Engineer” wherever they appear in the Contract Documents.

ARTICLE 3 -- BIDDING DOCUMENTS

3.4 ADDENDA

Delete subparagraph 3.4.3 in its entirety.

ARTICLE 4 -- BIDDING PROCEDURES

4.4 MODIFICATION OR WITHDRAWAL OF BID

At subparagraph 4.4.1, change the phrase “stipulated time” to read “thirty days”.

Add paragraph 4.5 as follows:

4.5 OTHER DOCUMENTS TO BE SUBMITTED WITH BID

4.5.1 A fully executed Affidavits. Refer to Document.

4.5.2 A fully executed Felony Conviction Notification form. Refer to Document.

4.5.3 A fully executed Affidavit of Non-Collusion. Refer to Document.

ARTICLE 5 -- CONSIDERATION OF BIDS

5.3 ACCEPTANCE OF BIDS (AWARD)

Delete Subparagraph 5.3.1 in its entirety and replace it with the following:

5.3.1 The OWNER shall select the OFFEROR that offers the best value for the OWNER based on the published selection criteria and on its ranking evaluation. The OWNER shall first attempt to negotiate with the selected OFFEROR a contract. The OWNER and its engineer or architect may discuss with the selected OFFEROR options for a scope or time modification and any price change associated with the modification. If the OWNER is unable to negotiate a contract with the selected OFFEROR, the OWNER 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.

Add the following subparagraphs:

5.3.3 In determining best value for the district, the district is not restricted to considering price alone, but may consider any other factor stated in the selection criteria.

5.3.4 It is the intent of the OWNER to award a Contract to the OFFEROR that offers the best value for the OWNER, according to the weighted selection criteria established by the OWNER.

5.3.5 The OWNER reserves the right to accept or reject any and/or all proposals, to accept the Proposal

that, in the OWNER'S judgment, is in the OWNER'S best interest, and to waive informalities or irregularities in a proposal received.

5.3.6 The OWNER will document the basis of its selection and will make the evaluations public not later than the seventh day after the date the contract is awarded.

5.3.7 Proposals received from nonresident Bidders will be evaluated by the Owner as required by House Bill 620, 69th Legislature, 1985.

ARTICLE 7 -- PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

At subparagraph 7.1.1, add the following clause at the end of the last sentence:

"except as required otherwise, refer to Supplementary Conditions, Article 11.5."

Delete subparagraph 7.1.3 in its entirety, and replace it with the following:

7.1.3 Bonding Companies (Sureties) shall comply with the requirements of Article 11 of the General Conditions and Supplementary Conditions.

Add Article 9 as follows:

ARTICLE 9 -- ADDITIONAL INFORMATION AND INSTRUCTIONS

9.1 SALES TAX

9.1.1 The Owner is exempt from all Sales Tax, refer to Supplementary Conditions, Article 3.

9.2 WAGE RATES

9.2.1 The Owner has adopted a schedule of minimum wage rates for employees used in the construction of this project, refer to Supplementary Conditions, Article 3.

9.3 HAZARDOUS MATERIALS

9.3.1 The use of any construction process or the installation of any materials containing the following is strictly prohibited on this project

- **.1** Asbestos
- **.2** Lead
- **.3** P.C.B. (Polychloride Biphenyls)
- **.4** Refrigerants R-11, R-12, R-113, R-114, R-500 and R-502

9.3.2 Prior to submitting a Proposal, each Offeror shall notify the Architect in writing of any materials or systems in the Bidding Documents which he has reason to believe contain any of the above listed items.

9.4 TOBACCO FREE CAMPUS

9.4.1 The Owner has designated their District as a tobacco free facility; therefore, the use of any tobacco will not be permitted anywhere on the project site at any time.

Add Article 10 as follows:

ARTICLE 10 –GENERAL TERMS AND CONDITIONS

10.1 The Ow er is soliciting sealed proposals on the merchandise, supplies, and/or equipment set forth in this proposal package.

a. The Owner will award proposals after an in depth evaluation of all Offerors utilizing the following criteria. The criterion is listed in order of relative weighted importance and will be used in the ranking of each line item(s) or proposal in whole. All factors will be used to insure vendor's compliance to product and/or service specification, including but not limited to requesting samples of alternate items. The District reserves the right to pick and choose on a per line item basis (cherry-pick) and award items to multiple vendors as necessary. Evaluations shall be based on all of the following criteria, including other factors specified in item (h):

(a) the purchase price; lowest price meeting specifications
(b) reputation of the vendor and of the vendor's goods or services;
(c) the quality of the vendor's goods or services;
(d) the extent to which the goods or services meet the district's needs;
(e) the vendor's past relationship with the district;
(f) the impact on the ability of the district to comply with laws and rules relating to historically underutilized businesses;
(g) the total long-term cost to the district to acquire the vendor's goods or services;
(h) Special criteria as it might relate to specific requirements:

- Vendor's ability to meet specific Delivery Schedule
- Results of quality analysis regarding:
- Stated performance specifications or specific Brand
- Quality standards/features compared to other submittals
- Financial strength/standing with statutory requirements
- Specific Circumstance Requirements as delineated in proposal requirements
- Capacity to provide Technical assistance - present and past
- Vendors' ability to respond regarding deficiencies or warranty
- To meet the purpose and intent of the described commodity

It is the intent of this district to evaluate proposal submittals and determine the award(s) to a Vendor(s) that derives the best value for the dollars spent. In order to facilitate the most advantageous situation to the district and to the proposers, the district will rank the proposals by most successful vendor to least. Any and all information available or specifically requested will be used for evaluation process and application of the criterion as stated. Some instances might require the awards to a specific number of vendors in an effort not to diminish the vendor's earnest interest in fulfilling his contractual obligation, i.e.: In cases where a vendor bids "all or nothing" on multiple line items and the overall effect to this condition results in an overall lowest bid of acceptable products. See Owner's Proposal Evaluation Matrix.

b. Specifications, as written meet specific requirements. Submittals (offers) different to the original requirements must meet or exceed original proposal specifications to be considered as equivalent. It is a mandatory requirement of these specifications, in order to qualify alternate (equal) products to those specifically named; that, complete material/product specifica-

tion-data sheets to be provided with the sealed proposal package as applicable. Failure to provide or denote this information will be sufficient grounds for disqualification. Should the proposer fail to denote his offer is for an alternate item: then, stated price will be accepted for the actual product specifically named. Resulting contracts/orders resulting from the award will be processed by a formal instrument (Purchase Order).

c. During the performance of this contract, the vendor agrees not to discriminate against any employee or applicant for employment because of race, color, national origin, age, religion, gender, marital or veteran status, or disabled condition.

d. All contracts and agreements between merchants and the Owner shall strictly adhere to the statutes as set forth in the Uniform Commercial Code as last amended in 1977 by the American Law Institute in the national Conference of Commissioners on Uniform State laws, or latest revision. Reference: Uniform Commercial Code, 1987 official text.

e. Merchandise received shall be newly manufactured merchandise. Refurbished or reconditioned merchandise will not be allowed, unless specifically required in the bid. Merchandise received in this condition will be returned freight collect at the vendors' expense. If this problem is not corrected within ten (10) working days of notification the Owner, under Uniform Commercial Code, will have the right to seek remedy.

f. Fund out provision: Should, during the term of the resulting contract, funding allocations be cut or exhausted Owner will be held harmless for any future obligations to the said contract.

END OF SECTION 00210

Contractor Ranking and Selection Approval Form

Date: November 3, 2026

Projects: CSP#16-SBHVAC-1226 San Benito HVAC/Controls

Construction Delivery Approach: Competitive Sealed Proposal (CSP), given the market is conducive for securing quality contractors when bidding this approach. This approach is a more cost-effective approach and is easier to manage from a funds management and contracts standpoint than other delivery methods.

Scoring Criteria and Weighting:

Pass/Fail Criteria

1. Ability to provide required bonding and insurance.
2. Ability to meet the project schedule.
3. Financial Stability as demonstrated by financial statements.
4. History of excessive litigation
5. Conflicts of interest
6. Criminal conviction history
7. Other legal status barring award of contract
8. Safety record

Proposed Questions & Information for Each Pass/Fail Category:

1. Provide a bid bond with a penal sum of 5% of the proposal amount, valid for two weeks after the proposal deadline. List your insurance carrier(s) and confirm ability to meet the insurance requirements published in the Request for Proposals.
2. Confirm ability to meet the project schedule published in the Request for Proposals.
3. IDEA is interested in understanding the stability of your firm in terms of managed growth. Provide financial statements for the past year (IDEA reserves the right to disqualify firms that cannot show financial stability in a satisfactory manner to the Owner. Financial information provided will not be shared with anyone outside of IDEA and the selection team.).
4. Provide a history of litigation your firm has been involved in during the past five years and the disposition of such litigation.
5. Provide the completed conflicts of interest form provided in the Request for Proposals.
6. Provide the completed criminal conviction form provided in the Request for Proposals.
7. Confirm that your firm is legally able to conduct business in the State of Texas and enter into construction contracts involving public funds.
8. Please provide your firm s Experience Modification Rate (EMR). If your EMR is above 1.0, please provide a copy of your firm s OSHA Form 300 for the past year and an explanation of any reported incidents.

Weighted Scoring Criteria

1. Cost (50 Points)
2. Firm Experience/Key Personnel and Firm Stability/Management (40 Points)
3. K-12 Construction Experience (5 Points)
4. Prior Experience with the Project Team including IDEA Public Schools, and/or the design team. (5 Points)

Proposed Questions & Information for Each Scoring Category:

Cost (50 Points)

Points will be awarded based on Offerors ratio to the lowest price received. Points will be awarded based on the following formula: Lowest Bid / Proposer s Bid x 50 = Points Received. As an example, the following sample scoring matrix is provided:

Proposer	Offeror s Proposed Cost	Calculation	Assigned Point Value
Contractor 1	$2,500,000	$2,500,000/$2,500,000 x 50 =	50
Contractor 2	$2,700,000	$2,500,000/$2,700,000 x 50 =	46
Contractor 3	$2,800,000	$2,500,000/$2,800,000 x 50 =	45
Contractor 4	$2,900,000	$2,500,000/$2,900,000 x 50 =	43
Contractor 5	$3,000,000	$2,500,000/$3,000,000 x 50 =	42

Relevant Firm Experience, Key Personnel, and Ability to Complete the Work (40 Points)

1. Include an organizational chart for your proposed management team. The proposed team will be evaluated based on their relevant experience and qualifications. Include, at a minimum, the name of the principal-in-charge for the firm as well as the following staff: project manager (primary decision maker), superintendent(s), project engineer, and safety manager. The safety manager may have other roles, such as project superintendent or project manager, but must be on-site full time. Staffing strength is significant to IDEA Public Schools and changes to proposed staff (or staff options) without the prior approval of IDEA Public Schools may be grounds for termination prior to construction phase services. 10 points
2. Provide information on a minimum of five projects of comparable type, size, and quality that your firm has completed in the last five years. Identify similar challenges and describe your approach. Regarding these projects, identify which staff members were on the featured projects, along with names and contact information for the related Owner and Architect. 15 points
3. Provide the number of Surety companies that your company has engaged over the last 2 years, the name(s) of the Surety company, and the number of years that your firm has consistently engaged the Surety company(ies). 5 points
4. Describe how your firm s quality control team will measure the quality of construction and commissioning and how will you address non-conforming work. 5 points
5. Describe your firm s warranty service support philosophy and your approach to warranty service implementation. 5 points

K-12 Construction Experience (5 Points)

Provide details of all K-12 school construction projects completed or underway over the past ten years. Provide contact information for the owner s representative for all projects completed in the last five years. Recent experience and experience of the proposed project team will receive highest consideration. 5 points

Prior Experience with the Project Team (5 Points)

Provide details of all projects completed with the client and/or design team. 5 points

NON-COLLUSION STATEMENT

The undersigned affirms that he/she is duly authorized to execute this contract, that this company, corporation, firm, partnership or individual has not prepared this proposal in collusion with any other offeror, and that the contents of this proposal as to prices, terms or conditions of said proposal have not been communicated by the undersigned nor by any employee or agent to any other person engaged in this type of business, or to any individual affiliated with the Owner prior to the official opening of this proposal.

NOTIFICATION OF CRIMINAL HISTORY OF CONTRACTOR

Texas Education Cod 44.034 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."

I, the undersigned authorized agent for the company named below; certify that I have complied with the procedures outlined above.

COMPANY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE_____

AREA CODE/FAX_____

E-MAIL ADDRESS_____

_____ _____

SIGNATURE TITLE

CERTIFICATE OF RESIDENCY

Texas Education Code Chapter 2252, Subchapter A. makes it necessary to determine the residency of bidders. In part, this law reads as follows:

Section 2252.001: Subchapter (3): "Non-resident Bidder" refers to a person who is not a resident of this state. Subchapter (4): "Resident Bidder" refers to a person, whose principal place of business is in this state, including a Bidder or Contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Section 2252.002: "A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident bidder underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresidents principal place of business is located."

I certify that

_____

Name of Bidding Company

Is, under Section 2252.001 (3) and (4), a

Please check one:

_____Resident Bidder or _____Non-Resident Bidder

My/our principal place of business under Section 2252.001 (3) and (4), is in the city of in

_____the state of_____

(a) Does your "Resident State" require bidders whose principal place of business is in Texas to underbid bidders whose residence state is the same as yours by a prescribed amount or percentage to receive a comparable contract?_Yes _____No

(b) If yes, what is amount of the percentage?_____%

_____ _____

Signature of Authorized Company Official Date

_____ _____

Printed Name of Official Title/Position of Company Official

Contractor Certification Form

Criminal History Record Information Review of Certain Contract Employees

Contractor must comply with Section 22.0834. Criminal History Record Information Review of Certain Contract Employees, Texas Education Code. Before work on this Contract begins, Contractor shall obtain criminal history record information through the criminal history clearinghouse as provided by Section 411.0845, Government Code relating to an employee or applicant who has or will have continuing duties related to the contracted services; and the employee or applicant has or will have direct contact with students. The Contractor must obtain criminal history record information before or immediately after employing or securing the services of the employee or applicant that has or will have continuing duties related to the contracted services if the employee or applicant has or will have direct contact with students. The Contractor further agrees that he shall assume all expenses associated with the criminal background check and shall immediately remove any employee or agent who was convicted of a felony, or misdemeanor involving moral turpitude, as defined by Texas law, from District property or the location where students are present.
Please visit Guide for School Contractors Section for additional information regarding Senate Bill 9.

I, the undersigned authorized agent for the company named below, certify that I have complied with the procedures outlined above.

First Name:_____ Last Name:_____

Enter Bid/RFP:_____

Yes, I certify that the Company/Firm does not have employees working where children are present

Company Name:_____

Address:_____

City:_____ State:_____ Zip:_____

Telephone:_____ Fax:_____

E-mail:_____ Signature:_____ Date_____

IMPORTANT

By submitting this form, I am indicating that I am complying with Senate Bill 9, Section 22.0834 Criminal History Record Information Review of Certain Contract Employees, Texas Education Code.

FELONY CONVICTION NOTIFICATION, DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION SIGNATURE PAGE *(***THIS NOTICE IS NOT REQUIRED OF A PUBLICLY HELD CORPORATION)**

I. 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 or 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 for services performed before the termination of the contract. This section does not apply to a publicly held corporation.

II. DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

(a) In accordance with the provisions of Appendix A to 49 CFR (Code of Federal Regulations), Part 29, the offeror certifies to the best of the offeror's knowledge and belief, that it and its principals:
   (1) are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State or Local Government department or agency;
   (2) have not within a three (3) year period preceding this offer been convicted of or had a civil judgment rendered against them for the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes, or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
   (3) are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local with commission of any of the offenses enumerated in (a)(2) above; and
   (4) have not within a three (3) year period preceding this offer had one or more public transactions (Federal, State, or local) terminated for cause or default.

(b) Where the offeror is unable to certify to any of the statements above, the offeror shall attach a full explanation to this offer.

(c) For any subcontract at any tier expected to equal or exceed $25,000:
   (1) In accordance with the provisions of Appendix B to 49 CFR, Part 29, the prospective lower tier subcontractor certifies, by submission of this offer, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
   (2) Where the prospective lower tier participant is unable to certify to the statement, above, an explanation shall be attached to the offer.

(3) This certification (specified in paragraphs (c) (1) and (c) (2), above), shall be included in all applicable subcontracts and a copy kept on file by the prime contractor. The prime contractor shall be required to furnish copies of the certifications to the Authority upon request.

Signature below acknowledges compliance with Section I. FELONY CONVICTION NOTIFICATION and Section II. DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION.

COMPANY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE_____

AREA CODE/FAX_____

E-MAIL ADDRESS_____

_____ _____

SIGNATURE TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS – UNLESS FIRM IS A PUBLICLY HELD CORPORATION

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor or other person doing business with local governmental entity

FORM CIQ
Page 1

This questionnaire is being filed in accordance with chapter 176 of the Local Government Code by a person doing business with the governmental entity.

By law this questionnaire must be filed with the records administrator of the local government not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. See section 176.006, Local Government Code.

A person commits an offense if the person violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.

OFFICE USE ONLY

Date Received

1. **Name of person doing business with local governmental entity.**

_____

2. ☐ **Check this box if you are filing an update to a previously filed questionnaire.**

(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than September 1 of the year for which an activity described in Section 176.006(a), Local Government Code, is pending and not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)

3. **Name each employee or contractor of the local governmental entity who makes recommendations to a local government officer of the governmental entity with respect to expenditures of money AND describe the affiliation or business relationship.**

_____

_____

_____

_____

_____

4. **Name each local governmental officer who appoints or employs local government officers of the governmental entity for which this questionnaire is filed AND describe the affiliation or business relationship.**

_____

_____

_____

_____

_____

5. **Name of local government officer with whom filer has affiliation or business relationship. (Complete this section only if the answers to A, B, or C is YES.**

This section, item 5 including subparts A, B, C & D, must be completed for each officer with whom the filer has affiliation or other relationship. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer named in this section receiving or likely to receive taxable income from the filer of the questionnaire?

☐ Yes ☐ No

B. Is the filer of the questionnaire receiving or likely to receive taxable income from or at the direction of the local government officer named in this section AND the taxable income is not from the local governmental entity?

☐ Yes ☐ No

C. Is the filer of this questionnaire affiliated with a corporation or other business entity that the local government officer serves as an officer or director, or holds an ownership of 10 percent of more?

☐ Yes ☐ No

D. Describe each affiliation or business relationship.

_____

_____

_____

_____

_____

6.

_____ _____

Signature of person doing business with the government entity Date

VENDOR CERTIFICATION OF COMPLIANCE WITH SB 253

PROHIBITION ON CONTRACTS WITH COMPANIES KNOWN TO HAVE CONTRACTS WITH, PROVIDE SUPPLIES OR SERVICES TO A FOREIGN TERRORIST ORGANIZATION.

Texas Government Code Chapter 2252, Section 2252.152 and Section 2252.153 states:

A BILL TO BE ENTITLED
AN ACT

relating to prohibiting governmental contracts with a company doing business with Iran, Sudan, or a foreign terrorist organization.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Chapter 2252, Government Code, is amended by adding Subchapter F to read as follows:

SUBCHAPTER F. PROHIBITION ON CONTRACTS WITH CERTAIN COMPANIES

Sec. 2252.151. DEFINITIONS. In this subchapter:

(1) "Company" has the meaning assigned by Section 806.001.

(2) "Foreign terrorist organization" means an organization designated as a foreign terrorist organization by the United States secretary of state as authorized by 8 U.S.C. Section 1189.

(3) "Governmental contract" means a contract awarded by a governmental entity for general construction, an improvement, a service, or a public works project or for a purchase of supplies, materials, or equipment. The term includes a contract to obtain a professional or consulting service subject to Chapter 2254.

(4) "Governmental entity" has the meaning assigned by Section 2252.001.

Sec. 2252.152. CONTRACTS WITH COMPANIES ENGAGED IN BUSINESS WITH IRAN, SUDAN, OR FOREIGN TERRORIST ORGANIZATION PROHIBITED. A governmental entity may not enter into a governmental contract with a company that is identified on a list prepared and maintained under Section 806.051, 807.051, or 2252.153.

Sec. 2252.153. LISTED COMPANIES. The comptroller shall prepare and maintain, and make available to each governmental entity, a list of companies known to have contracts with or provide supplies or services to a foreign terrorist organization.

SECTION 2. Subchapter F, Chapter 2252, Government Code, as added by this Act, applies only to a contract or purchase for which a governmental entity first advertises or otherwise solicits bids, proposals, offers, or qualifications on or after the effective date of this Act.

SECTION 3. This Act takes effect September 1, 2017.

I acknowledge compliance with Texas Government Code Chapter 2252 that my company does not and will not have contracts with or provide supplies or services to a foreign terrorist organization during the term of this contract.

COMPANY _____

BY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE_____

AREA CODE/FAX_____

E-MAIL ADDRESS_____

_____ _____
SIGNATURE TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

L. PROHIBITION ON CONTRACTS WITH COMPANIES BOYCOTTING ISRAEL

H.B. No. 89, Sec. 2270.002 states:

A governmental entity may not enter into a contract with a company for goods or services unless the contract contains a written verification from the company that it:

(1) does not boycott Israel; and

(2) will not boycott Israel during the term of the contract.

For complete copy of H.B. No 89, Sec. 2270.002 please click here: ftp://ftp.legis.state.tx.us/bills/85R/billtext/html/house_bills/HB00001_HB00099/HB00089S.htm

I acknowledges compliance with Texas H.B. No 89, Sec. 2270.002 that my company does not boycott Israel and will not boycott Israel during the term of this contract.

COMPANY _____

BY _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

AREA CODE/TELEPHONE_____

AREA CODE/FAX_____

E-MAIL ADDRESS_____

_____ _____

SIGNATURE TITLE

THIS FORM MUST BE SIGNED AND INCLUDED WITH SUBMITTAL OF PROPOSALS

Form **W-9**
(Rev. October 2018)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

► **Go to *www.irs.gov/FormW9* for instructions and the latest information.**

Give Form to the requester. Do not send to the IRS.

Print or type. See **Specific Instructions** on page 3.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only **one** of the following seven boxes.

☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate

☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ► _____

Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is **not** disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner.

☐ Other (see instructions) ►

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any) _____

Exemption from FATCA reporting code (if any) _____

(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.) See instructions.

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN,* later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number

			–			–				

or

Employer identification number

		–							

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here	**Signature of U.S. person** ►	**Date** ►

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9.*

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, *later.*

000400 – BID PROPOSAL FORM

PROJECT TITLE: **IDEA Public Schools San Benito HVAC/Controls**

PROPOSAL NO: **CSP 16-SBHVAC-1226**

DUE DATE, TIME &: Thursday, November 19, 2026 at 2:00 pm
PLACE: Idea Public Schools Head Quarters
2115 W. Pike Blvd., Weslaco, TX 78596

1. The undersigned OFFEROR proposes and agrees, if this proposal is accepted, to enter into an Agreement with OWNER to provide and install Equipment and Materials as specified or indicated in the Contract Documents for the Contract Price and within the Contract, Time indicated in this Proposal and in accordance with the Contract Documents.

2. OFFEROR accepts all of the terms and conditions of the Instructions to Bidders and Supplementary Instructions to Bidders. This Proposal shall remain in effect for a period of no less than sixty (60) days after the date of Proposal opening.

3. In submitting this Bid, OFFEROR certifies that:

   (a) OFFEROR has examined copies of all the Contact Documents and the following Addenda:

Date	Number
_____	_____
_____	_____
_____	_____

   (receipt of all of which is hereby acknowledged) and also copies of the Advertisement or Invitation to Submit Proposal and the Instructions to BIDDERS; and

   (b) This Proposal is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; OFFEROR has not directly or indirectly induced or solicited any other OFFEROR to submit a false or sham Bid; OFFEROR has not solicited or induced any person, firm or a corporation to refrain from proposing; and OFFEROR has not sought by collusion to obtain for himself any advantage over any other OFFEROR or over OWNER.

4. Project Deadlines and Penalties: This provision shall be enforced, except in the event of inclement weather, unnecessary delay caused by OWNER or his agent, or other natural disaster or Act of God beyond Contractor's control.

   (a) For penalties, refer to AIA Contract between Owner and Contractor, along with all applicable amendments.

5. Communications concerning this Proposal shall be addressed to:

Cesar Gonzalez, PE

000400 – BID PROPOSAL FORM

1126 South Commerce
Harlingen, Texas 78550
Phone: (956) 230-3435; Fax: (956) 720-0830
Email: cgonzalez@ethoseng.net

NOTICE:
In determining the best value for the district, the district is not restricted to considering price alone but may consider any other factor stated in the selection criteria.

It is the intent of the OWNER to award a Contract to the OFFEROR that offers the best value for the OWNER, according to the following weighted selection criteria established by the OWNER.

The OWNER reserves the right to accept or reject any and/or all Bids, to accept the Proposal that, in the OWNER'S judgment, is in the OWNER'S best interest, and to waive informalities or irregularities in a Proposal received.

The OWNER will document the basis of its selection and will make the evaluations public not later than the seventh day after the date the contract is awarded.

Bids received from nonresident Offerors will be evaluated by the Owner as required by House Bill 620, 69th Legislature, 1985.

OFFEROR will supply and install on-site mechanical/electrical equipment and services as specified in the Project Manual dated **November 3, 2026** for the following price:

BASE PROPOSAL: For Turnkey Project, with **ALC WebCTRL Controls**
[Proposal amount includes Allowances as per specifications section 012100].

$_____ (number)

_____ (words)

ALTERNATE PROPOSAL: For Turnkey Project, with **JCI Metasys Controls** in lieu of ALC.
The scope of work is complete and equal to that of Base Proposal.
[Proposal amount includes Allowances as per specifications section 012100].

$_____ (number)

_____ (words)

PROPOSED SUBSTANTIAL COMPLETION DATE of the project in its entirety.
(Recommended date of substantial completion: August 1, 2027)

_____

000400 – BID PROPOSAL FORM

Our Proposal proposes to use the following Contractors, Subcontractors, Manufacturers, Products, Material Suppliers and Equipment Suppliers for the principal portions of the work.

NAME(S) OF SUB-CONTRACTORS:

_____

_____

NAME(S) OF EQUIPMENT SUPPLIERS:

DX ACCUs:

_____

_____

DX AHUs:

_____

_____

OTHER:

_____

_____

000400 – BID PROPOSAL FORM

Name and Address of OFFEROR:

_____

_____

_____

Telephone _____

Signature

_____
Name and Title

_____

_____

Sworn to and subscribed before me this _____ day of _____, 2026.

SEAL

_____
Notary Public in and for the State of Texas

SEAL (If Proposal is By a Corporation) _____

AIA® Document A101™ – 2017

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

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

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

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

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

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

The Owner and Contractor agree as follows.

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

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

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

AIA Document A101™ – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017 by The American Institute of Architects. **All rights reserved.** WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This document was produced by AIA software at 17:40:37 ET on 02/07/2019 under Order No. 9430698470 which expires on 05/25/2019, and is not for resale.
User Notes:
(3B9ADA52)

Init.
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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

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

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

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

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

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

Init.

/

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(Check one of the following boxes and complete the necessary information.)

[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be Zero Dollars and Zero Cents ($ 0.00), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

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

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than ( ) days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

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

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

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

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§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

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

§ 5.2 Final Payment

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

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

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§ 6.2 Binding Dispute Resolution
For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[ ] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION
§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

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

ARTICLE 8 MISCELLANEOUS PROVISIONS
§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

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

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

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§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

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

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

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[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

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

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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SUPPLEMENTARY CONDITIONS TO THE STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR AIA DOCUMENT A-101 2017

The Supplementary Conditions contain modifications and additions to the Standard Form of Agreement between Owner and Contractor, AIA Document A101—2017 Edition. Where any part of the AIA A101—2017 is modified or voided by the Supplementary Conditions, the unaltered portions shall remain in effect.

All references to the AIA A201—2017 shall mean the AIA Document AIA A201–2017 as modified by Owner.

ARTICLE 4 – Contract Sum

4.5 Liquidated Damages: Owner and Contractor recognize that time is of the essence in this Agreement and that Owner will suffer financial loss if the Work is not completed within the time specified in Paragraph 3.1 above, plus any extension thereof allowed in accordance with Article 8 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring such proof, Owner and Contractor agree that as liquidated damages for delay (but not as penalty) Contractor shall pay Owner **Five Hundred Dollars ($500.00)** for each day that expires after the time specified in Paragraph 3.1 for Substantial Completion until the work is substantially complete.

In addition to the liquidated damages outlines above, the Contractor and the Contractor's Surety shall be liable for and shall pay the Owner the sum of Five Hundred Dollars ($500.00) as damages for each calendar day after the project has been substantially complete and the Architect and MEP punch lists have been not been satisfactorily corrected within thirty (30) days of Substantial Acceptance.

The Contractor and the Contractor's Surety shall be liable for and shall pay the Owner the sum herein stipulated as One Thousand Dollars ($1,000.00) for damages per calendar day if those items on the Architect and MEP punch lists have been not been satisfactorily corrected within forty five (45) days of Substantial Acceptance.

In further agreed that the Contractor and the Contractor's Surety shall be liable for and pay to the Owner as damages the sum of One Thousand Five Hundred Dollars ($1,500.00) per day if these items on the Architect and MEP punch lists have been not been satisfactorily corrected within sixty (60) days of Substantial Acceptance, and until they are corrected.

ARTICLE 5 – Payments

5.1.3 Delete this paragraph in its entirety and replace with the following: "Contractor shall submit an Application for Payment to the Architect by the **1st** of the month. Architect shall have seven **(7) days** to approve or reject the

application for payment. Owner shall pay Contractor within **30 days** of receipt of an approved Application of Payment from the Architect. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner no later than **30 days** after the Architect approves the Application for Payment. A draft pencil review of the Application for Payment prior to the approval date may be conducted to facilitate the approval process."

Delete paragraphs 5.1.7.1.1, 5.1.7.2, and 5.1.7.3 in their entirety.

5.2.2 At the end of the paragraph delete "or as follows" and insert "and upon acceptance by the Owner and Architect, and after satisfactory evidence has been given by the Contractor that all his bills have been paid and the entire project is free from liens."

ARTICLE 6 Dispute Resolution

6.2 Check the second box, "Litigation in a court of competent jurisdiction."

ARTICLE 7 Termination or Suspension

7.1.1 Delete this paragraph in its entirety

ARTICLE 8 Miscellaneous Provision

8.6 Delete this paragraph in its entirety

8.7 Family Code Child Support Certification. By signing the Agreement, the Contractor certifies as follows: "Under Section 231.006, *Texas Family Code*, the vendor or applicant certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate.".

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

EXHIBIT A – Insurance and Bonds

Refer to AIA 2017 Supplemental Instructions, Section 11.1

AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

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

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

TABLE OF ARTICLES

1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 ARCHITECT

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

9 PAYMENTS AND COMPLETION

10 PROTECTION OF PERSONS AND PROPERTY

11 INSURANCE AND BONDS

12 UNCOVERING AND CORRECTION OF WORK

13 MISCELLANEOUS PROVISIONS

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

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INDEX
(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work
9.6.6, 9.9.3, **12.3**
Acceptance of Work
9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3
Access to Work
3.16, 6.2.1, 12.1
Accident Prevention
10
Acts and Omissions
3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.3.2, 14.1, 15.1.2, 15.2
Addenda
1.1.1
Additional Costs, Claims for
3.7.4, 3.7.5, 10.3.2, 15.1.5
Additional Inspections and Testing
9.4.2, 9.8.3, 12.2.1, **13.4**
Additional Time, Claims for
3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**
Administration of the Contract
3.1.3, **4.2**, 9.4, 9.5
Advertisement or Invitation to Bid
1.1.1
Aesthetic Effect
4.2.13
Allowances
3.8
Applications for Payment
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10
Approvals
2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10.1, 4.2.7, 9.3.2, 13.4.1
Arbitration
8.3.1, 15.3.2, **15.4**
ARCHITECT
4
Architect, Definition of
4.1.1
Architect, Extent of Authority
2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1
Architect, Limitations of Authority and Responsibility
2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2
Architect's Additional Services and Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect's Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5
Architect's Approvals
2.5, 3.1.3, 3.5, 3.10.2, 4.2.7
Architect's Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect's Copyright
1.1.7, 1.5
Architect's Decisions
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.4.2, 15.2
Architect's Inspections
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4
Architect's Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect's Interpretations
4.2.11, 4.2.12
Architect's Project Representative
4.2.10
Architect's Relationship with Contractor
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2
Architect's Relationship with Subcontractors
1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3
Architect's Representations
9.4.2, 9.5.1, 9.10.1
Architect's Site Visits
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Asbestos
10.3.1
Attorneys' Fees
3.18.1, 9.6.8, 9.10.2, 10.3.3
Award of Separate Contracts
6.1.1, 6.1.2
Award of Subcontracts and Other Contracts for Portions of the Work
5.2
Basic Definitions
1.1
Bidding Requirements
1.1.1
Binding Dispute Resolution
8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1
Bonds, Lien
7.3.4.4, 9.6.8, 9.10.2, 9.10.3
Bonds, Performance, and Payment
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**, 11.1.3, **11.5**
Building Information Models Use and Reliance
1.8
Building Permit
3.7.1
Capitalization
1.3
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5
Certificates for Payment

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User Notes:
(3B9ADA41)

4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4
Certificates of Inspection, Testing or Approval
13.4.4
Certificates of Insurance
9.10.2
Change Orders
1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
Change Orders, Definition of
7.2.1
CHANGES IN THE WORK
2.2.2, 3.11, 4.2.8, 7, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5
Claims, Definition of
15.1.1
Claims, Notice of
1.6.2, 15.1.3
CLAIMS AND DISPUTES
3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4
Claims and Timely Assertion of Claims
15.4.1
Claims for Additional Cost
3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**
Claims for Additional Time
3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**
Concealed or Unknown Conditions, Claims for
3.7.4
Claims for Damages
3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7
Claims Subject to Arbitration
15.4.1
Cleaning Up
3.15, 6.3
Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**
Commencement of the Work, Definition of
8.1.2
Communications
3.9.1, **4.2.4**
Completion, Conditions Relating to
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2
COMPLETION, PAYMENTS AND
9
Completion, Substantial
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2
Compliance with Laws
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3
Concealed or Unknown Conditions
3.7.4, 4.2.8, 8.3.1, 10.3
Conditions of the Contract
1.1.1, 6.1.1, 6.1.4
Consent, Written
3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2
Consolidation or Joinder
15.4.4
CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
1.1.4, **6**
Construction Change Directive, Definition of
7.3.1
Construction Change Directives
1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1
Construction Schedules, Contractor's
3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Contingent Assignment of Subcontracts
5.4, 14.2.2.2
Continuing Contract Performance
15.1.4
Contract, Definition of
1.1.2
CONTRACT, TERMINATION OR SUSPENSION OF THE
5.4.1.1, 5.4.2, 11.5, **14**
Contract Administration
3.1.3, 4, 9.4, 9.5
Contract Award and Execution, Conditions Relating to
3.7.1, 3.10, 5.2, 6.1
Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3
Contract Documents, Definition of
1.1.1
Contract Sum
2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5, 15.2.5**
Contract Sum, Definition of
9.1
Contract Time
1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
Contract Time, Definition of
8.1.1
CONTRACTOR
3
Contractor, Definition of
3.1, 6.1.2
Contractor's Construction and Submittal Schedules
3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
Contractor's Employees

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2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1
Contractor's Liability Insurance
11.1
Contractor's Relationship with Separate Contractors and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4
Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1
Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2
Contractor's Responsibility for Those Performing the Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8
Contractor's Review of Contract Documents
3.2
Contractor's Right to Stop the Work
2.2.2, 9.7
Contractor's Right to Terminate the Contract
14.1
Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3
Contractor's Superintendent
3.9, 10.2.6
Contractor's Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4
Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11
Copyrights
1.5, **3.17**
Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1
Correlation and Intent of the Contract Documents
1.2
Cost, Definition of
7.3.4
Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14
Cutting and Patching
3.14, 6.2.5
Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
Date of Commencement of the Work, Definition of
8.1.2
Date of Substantial Completion, Definition of
8.1.3
Day, Definition of
8.1.4
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2
Decisions to Withhold Certification
9.4.1, **9.5**, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1
Delays and Extensions of Time
3.2, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5
Digital Data Use and Transmission
1.7
Disputes
6.3, 7.3.9, 15.1, 15.2
Documents and Samples at the Site
3.11
Drawings, Definition of
1.1.5
Drawings and Specifications, Use and Ownership of
3.11
Effective Date of Insurance
8.2.2
Emergencies
10.4, 14.1.1.2, **15.1.5**
Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1
Equipment, Labor, or Materials
1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2, 10.4, 14.3, 15.1.6, **15.2.5**

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User Notes:

(3B9ADA41)

Failure of Payment
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Faulty Work
(See Defective or Nonconforming Work)
Final Completion and Final Payment
4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3
Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4
GENERAL PROVISIONS
1
Governing Law
13.1
Guarantees (See Warranty)
Hazardous Materials and Substances
10.2.4, **10.3**
Identification of Subcontractors and Suppliers
5.2.1
Indemnification
3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3
Information and Services Required of the Owner
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5, 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Initial Decision
15.2
Initial Decision Maker, Definition of
1.1.8
Initial Decision Maker, Decisions
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Initial Decision Maker, Extent of Authority
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Injury or Damage to Person or Property
10.2.8, 10.4
Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 12.2.1, 13.4
Instructions to Bidders
1.1.1
Instructions to the Contractor
3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2
Instruments of Service, Definition of
1.1.7
Insurance
6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, **11**
Insurance, Notice of Cancellation or Expiration
11.1.4, 11.2.3
Insurance, Contractor's Liability
11.1
Insurance, Effective Date of
8.2.2, 14.4.2
Insurance, Owner's Liability
11.2
Insurance, Property
10.2.5, 11.2, 11.4, 11.5
Insurance, Stored Materials
9.3.2
INSURANCE AND BONDS
11
Insurance Companies, Consent to Partial Occupancy
9.9.1
Insured loss, Adjustment and Settlement of
11.5
Intent of the Contract Documents
1.2.1, 4.2.7, 4.2.12, 4.2.13
Interest
13.5
Interpretation
1.1.8, 1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1
Interpretations, Written
4.2.11, 4.2.12
Judgment on Final Award
15.4.2
Labor and Materials, Equipment
1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Labor Disputes
8.3.1
Laws and Regulations
1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Liens
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Limitations, Statutes of
12.2.5, 15.1.2, 15.4.1.1
Limitations of Liability
3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6, 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3, 11.3, 12.2.5, 13.3.1
Limitations of Time
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7, 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15, 15.1.2, 15.1.3, 15.1.5
Materials, Hazardous
10.2.4, **10.3**
Materials, Labor, Equipment and
1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
Means, Methods, Techniques, Sequences and Procedures of Construction
3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
Mechanic's Lien
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Mediation
8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1, 15.4.1.1
Minor Changes in the Work
1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, **7.4**
MISCELLANEOUS PROVISIONS
13

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User Notes:

(3B9ADA41)

Modifications, Definition of
1.1.1
Modifications to the Contract
1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2
Mutual Responsibility
6.2
Nonconforming Work, Acceptance of
9.6.6, 9.9.3, **12.3**
Nonconforming Work, Rejection and Correction of
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2
Notice
1.6, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1
Notice of Cancellation or Expiration of Insurance
11.1.4, 11.2.3
Notice of Claims
1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1
Notice of Testing and Inspections
13.4.1, 13.4.2
Observations, Contractor's
3.2, 3.7.4
Occupancy
2.3.1, 9.6.6, 9.8
Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1
OWNER
2
Owner, Definition of
2.1.1
Owner, Evidence of Financial Arrangements
2.2, 13.2.2, 14.1.1.4
Owner, Information and Services Required of the
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Owner's Authority
1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7
Owner's Insurance
11.2
Owner's Relationship with Subcontractors
1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2
Owner's Right to Carry Out the Work
2.5, 14.2.2
Owner's Right to Clean Up
6.3
Owner's Right to Perform Construction and to Award Separate Contracts
6.1
Owner's Right to Stop the Work
2.4
Owner's Right to Suspend the Work
14.3
Owner's Right to Terminate the Contract
14.2, 14.4
Ownership and Use of Drawings, Specifications and Other Instruments of Service
1.1.1, 1.1.6, 1.1.7, **1.5**, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3
Partial Occupancy or Use
9.6.6, **9.9**
Patching, Cutting and
3.14, 6.2.5
Patents
3.17
Payment, Applications for
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3
Payment, Certificates for
4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4
Payment, Failure of
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Payment, Final
4.2.1, 4.2.9, **9.10**, 12.3, 14.2.4, 14.4.3
Payment Bond, Performance Bond and
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
Payments, Progress
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
PAYMENTS AND COMPLETION
9
Payments to Subcontractors
5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
PCB
10.3.1
Performance Bond and Payment Bond
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
Permits, Fees, Notices and Compliance with Laws
2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2
PERSONS AND PROPERTY, PROTECTION OF
10
Polychlorinated Biphenyl
10.3.1
Product Data, Definition of
3.12.2
Product Data and Samples, Shop Drawings
3.11, **3.12**, 4.2.7
Progress and Completion
4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4
Progress Payments
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
Project, Definition of
1.1.4

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User Notes:

(3B9ADA41)

Project Representatives
4.2.10
Property Insurance
10.2.5, **11.2**
Proposal Requirements
1.1.1
PROTECTION OF PERSONS AND PROPERTY
10
Regulations and Laws
1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Rejection of Work
4.2.6, 12.2.1
Releases and Waivers of Liens
9.3.1, 9.10.2
Representations
3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1
Representatives
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1
Responsibility for Those Performing the Work
3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10
Retainage
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3
Review of Contract Documents and Field Conditions by Contractor
3.2, 3.12.7, 6.1.3
Review of Contractor's Submittals by Owner and Architect
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2
Review of Shop Drawings, Product Data and Samples by Contractor
3.12
Rights and Remedies
1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2, 12.2.4, **13.3**, 14, 15.4
Royalties, Patents and Copyrights
3.17
Rules and Notices for Arbitration
15.4.1
Safety of Persons and Property
10.2, 10.4
Safety Precautions and Programs
3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4
Samples, Definition of
3.12.3
Samples, Shop Drawings, Product Data and
3.11, **3.12**, 4.2.7
Samples at the Site, Documents and
3.11
Schedule of Values
9.2, 9.3.1
Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Separate Contracts and Contractors
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
Separate Contractors, Definition of
6.1.1
Shop Drawings, Definition of
3.12.1
Shop Drawings, Product Data and Samples
3.11, **3.12**, 4.2.7
Site, Use of
3.13, 6.1.1, 6.2.1
Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4
Site Visits, Architect's
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Special Inspections and Testing
4.2.6, 12.2.1, 13.4
Specifications, Definition of
1.1.6
Specifications
1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
Statute of Limitations
15.1.2, 15.4.1.1
Stopping the Work
2.2.2, 2.4, 9.7, 10.3, 14.1
Stored Materials
6.2.1, 9.3.2, 10.2.1.2, 10.2.4
Subcontractor, Definition of
5.1.1
SUBCONTRACTORS
5
Subcontractors, Work by
1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7
Subcontractual Relations
5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3
Submittal Schedule
3.10.2, 3.12.5, 4.2.7
Subrogation, Waivers of
6.1.1, **11.3**
Substances, Hazardous
10.3
Substantial Completion
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 15.1.2
Substantial Completion, Definition of
9.8.1
Substitution of Subcontractors
5.2.3, 5.2.4
Substitution of Architect
2.3.3
Substitutions of Materials
3.4.2, 3.5, 7.3.8
Sub-subcontractor, Definition of
5.1.2
Subsurface Conditions
3.7.4

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User Notes:
(3B9ADA41)

Successors and Assigns
13.2
Superintendent
3.9, 10.2.6
Supervision and Construction Procedures
1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6, 9.10.5, 14.2.1
Surety
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2, 15.2.7
Surety, Consent of
9.8.5, 9.10.2, 9.10.3
Surveys
1.1.7, 2.3.4
Suspension by the Owner for Convenience
14.3
Suspension of the Work
3.7.5, 5.4.2, 14.3
Suspension or Termination of the Contract
5.4.1.1, 14
Taxes
3.6, 3.8.2.1, 7.3.4.4
Termination by the Contractor
14.1, 15.1.7
Termination by the Owner for Cause
5.4.1.1, **14.2**, 15.1.7
Termination by the Owner for Convenience
14.4
Termination of the Architect
2.3.3
Termination of the Contractor Employment
14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT
14
Tests and Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 12.2.1, **13.4**
TIME
8
Time, Delays and Extensions of
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5
Time Limits
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2, 15.1.3, 15.4
Time Limits on Claims
3.7.4, 10.2.8, 15.1.2, 15.1.3
Title to Work
9.3.2, 9.3.3
UNCOVERING AND CORRECTION OF WORK
12
Uncovering of Work
12.1
Unforeseen Conditions, Concealed or Unknown
3.7.4, 8.3.1, 10.3
Unit Prices
7.3.3.2, 9.1.2
Use of Documents
1.1.1, 1.5, 2.3.6, 3.12.6, 5.3
Use of Site
3.13, 6.1.1, 6.2.1
Values, Schedule of
9.2, 9.3.1
Waiver of Claims by the Architect
13.3.2
Waiver of Claims by the Contractor
9.10.5, 13.3.2, **15.1.7**
Waiver of Claims by the Owner
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**
Waiver of Consequential Damages
14.2.4, 15.1.7
Waiver of Liens
9.3, 9.10.2, 9.10.4
Waivers of Subrogation
6.1.1, **11.3**
Warranty
3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2, 15.1.2
Weather Delays
8.3, 15.1.6.2
Work, Definition of
1.1.3
Written Consent
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2
Written Interpretations
4.2.11, 4.2.12
Written Orders
1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents 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 (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

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

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§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set

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forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

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

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§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

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

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

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

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§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. 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.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

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

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

§ 3.4 Labor and Materials

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

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§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

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

§ 3.5 Warranty

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

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

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

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately

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suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

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

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

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

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

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

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

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

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

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

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§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

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

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

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§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not

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have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

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§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

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 that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will

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similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the

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Work 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. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;

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.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor

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change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

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§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot

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be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

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§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented

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to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;

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.3 terms of special warranties required by the Contract Documents; or
.4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;
.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, 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 cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The

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Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds

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of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

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§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the

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other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

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ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,

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the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

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§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the

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Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

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§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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SUPPLEMENTARY CONDITIONS
TO THE GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION
AIA DOCUMENT A201-2017
IDEA PUBLIC SCHOOLS

A. The Supplementary Conditions contain modifications and additions to the General Conditions of the Contract for Construction, AIA Document A201-2017 Edition. Where any part of the AIA General Conditions is modified or voided by the Supplementary Conditions, the unaltered portions shall remain in effect. The paragraph numbering system of AIA Document A-201-2017 Edition, is continued in the Supplementary Conditions.

B. The following paragraphs and subparagraphs take precedence over the Agreement and General Conditions. Where any part of the Agreement or General Conditions are modified or deleted by the Supplementary Conditions, the unaltered provisions remain in effect.

C. Paragraph numbers and titles refer to like numbers and titles in the Agreement and General Conditions.

ARTICLE 1 – GENERAL PROVISIONS

1.1 Basic Definitions

1.1.1 The Contract Documents

1.1.1 In line 6, after "Architect" delete "." and insert "pursuant to Paragraph 7.4." In line 6 delete "Unless specifically enumerated in the Agreement" and replace with, "At the Owner's option,"

Insert new 1.1.1.1 as follows:

1.1.1.1 Contractor acknowledges and warrants that it has closely examined all the Contract Documents and is unaware of any instance where the documents are not suitable or are insufficient, to enable the Contractor to complete the Work in a timely manner for the Contract sum, and that they include all Work, whether or not shown or described, which reasonably may be inferred or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances, and regulations."

1.1.2 The Contract

1.1.2 In line 5 after "Sub-Subcontractor" insert the following, "(except as provided in Paragraph 5.3 and 5.4 hereof)". In line 7 after "obligations" insert "of Contractor".

1.1.3 The Work

Insert new 1.1.3.1 as follows:

1.1.3.1 The Work shall include the obligation of the Contractor to visit the site of the project before submitting a proposal. Such site visit shall be for the purpose of familiarizing Contractor with the conditions as they exist and the character of the operations to be carried on under the Contract Document, including all existing site conditions, access to the site, physical characteristics of the site and surrounding areas. It also includes all supplies, skill, supervision, transportation services and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the Contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

1.1.4 <u>The Project</u>

1.1.4 At the end of the paragraph delete the "." and insert the following, "wherever located and whenever issued."

1.2 <u>Correlation and Intent of the Contract Documents</u>

1.2.1 At the end of the paragraph insert the following, "Any differences between the requirements of the Drawings and the Specifications or any differences noted within the Drawings themselves or within the Specifications themselves have been referred to Owner and Architect by Contactor prior to the submission of bids and have been clarified by an Addendum issued to all bidders."

"If such differences or conflicts were not called to Owner's and Architect's attentions prior to submission of bids, Architect shall decide which of the conflicting requirements will govern based upon the following: the most stringent of the requirements will take precedence over the less stringent; the most expensive item will take precedence over the less expensive, and subject to the approval of Owner, Contractor shall perform the Work in accordance with the Architect's decision, without change to the Contract Sum or Contract Time. Work not covered in the Contract Documents will not be required unless it is consistent therewith and is reasonably inferable as being necessary to produce the intended results referenced in the Contract Documents."

Insert new 1.2.1.2 as follows:

1.2.1.2 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

.1 The Agreement;
.2 Addenda, with those of later date having precedence over those of earlier date;
.3 Supplementary Conditions issued by the Owner;
.4 The General Conditions of the Contact for Construction;
.5 Specifications;

.6 Drawings, in the case of inconsistency between the Drawings and Specifications or within either document, not clarified by Addendum, the better quality or greater quantity of Work shall be included in the Contract Documents. Clarifications of the inconsistency will be accomplished with the Contractor and, if necessary, an appropriate reduction in the contract will be accomplished by Change Order. Figures given on drawings govern scale measurements. Large scale drawings take precedence over small scale drawings. Written words take precedence over numbers. Handwritten documents take precedence over typewritten documents. Existing conditions take precedence over drawings and specifications for dimensions and shall be verified by the Contractor. The Contractor proceeds at his own risk if conflicts or discrepancies are not resolved prior to the execution of the Work.

Insert new 1.2.1.3 as follows:

1.2.1.3 If Work is required in a manner to make it impossible to produce Work of the quality required by or reasonably inferred from the Contract Documents, or should discrepancies appear among the Contract Documents, Contractor shall request in writing an interpretation from Architect before proceeding with the Work. If Contractor fails to make such request, no excuse will thereafter be entertained for failure to carryout Work in the required manner or provide required guarantees, warranties, or bonds, and Contractor shall not be entitled to any change in the Contract Sum or the Contract Time on account of such failure.

1.5 Ownership and Use of Drawings, Specifications and Other Instruments of Service

1.5.1 Delete the first sentence in its entirety and replace with the following: “Instruments of Service, including the Drawings, Specifications, and other similar or related documents and copies thereof are furnished to Contractor for the purpose of performing the Work and are, and shall remain, the property of Owner and Owner will retain all common law, statutory and other reserved rights, including copyrights.” In line 6 delete “Architect or Architect’s consultants’” and replace with: “Owner or Owners’ consultants.” Add the following at the end of the paragraph: “Neither the Contractor nor any subcontractor may utilize the Instruments of Service on other projects without the written consent of the Owner and the Architect.”

ARTICLE 2 – OWNER

2.1 General

Delete the existing Paragraph 2.1.1 and replacing it with the following paragraph:

2.1.1 The Owner is the person or entity identified as such in the Agreement and is

referred to throughout the Contract Documents as if singular in number. Owner's Board of Trustees has designated the Chief Executive Officer, Chief Operating Officer, and Chief Financial Officer, with the power to enter into a Contract, to execute a change order requiring an increase in the Contract Sum, or agreements to extend the contractual completion date. Project Management Services, Inc. (may be referred to as "Project Manager"), is an authorized representative to act on its behalf during the course of construction and any decisions made by the Project Manager effecting cost or extensions of contract time must be ratified by one of the Owner's Chief Officers.

2.1.2 Replace paragraph 2.1.2 in its entirety with the following:

Notice regarding construction project financing; Unlike a traditional school district where a bond election must be held and approved before major construction projects are undertaken, charter schools such as the Owner are authorized to use interim financing, traditional bank financing and to issue tax exempt bonds that do not require an election. Owner typically uses a combination of the above, and proceeds with construction using an available line of credit before issuing bonds to finance the completed project. Responding bidders and the selected contractor acknowledge the financing plan of the Owner and agree that they will comply with Owner's notice to proceed and commence construction when and as directed, in order to meet Owner's construction timelines.

2.3 Information and Services Required of the Owner

2.3.4 In line 1 after, "characteristics" insert "and" and delete "and utility locations". At the end of the paragraph insert the following, "In connection with the foregoing, Contractor shall be solely responsible for locating (and shall locate prior to performing any Work) all utility lines, telephone company lines and cable, sewer lines, water pipes, gas lines, electrical lines, including without limitation, all buried pipelines and buried telephone cables and shall perform the Work in such a manner so as to avoid damaging any such lines, cables, pipes and pipelines"

2.3.6 At the end of the sentence delete the "." and insert the following, "for use on this Project. All costs of reproduction are the responsibility of Contactor."

2.4 Owner's Right to Stop the Work

2.4 In line two after, "Contract Documents" insert the following, "or fails to remove and discharge (within ten (10) days) any lien filed upon Owner's or Landlord's property by anyone claiming by, through, or under Contractor; or disregards the instructions of Architect or Owner when based on the requirements of the Contract Documents". At the end of the paragraph delete "." and insert the following, ", and any delay resulting from such Work stoppage shall not extend any Milestone Date identified in the Contract for Construction or the required dates of Substantial or Final Completion."

2.5 Owner's Right to Carry Out the Work

Insert new 2.5.1 as follows:

2.5.1 The rights stated in Article 2 shall be in addition and not in limitation of any other rights of Owner granted in the Contract Documents or at law or in equity.

Insert new 2.6 and 2.6.1:

2.6 For any charges submitted for payment based upon costs incurred by the Contractor, the Owner shall be entitled to audit all records of the Contractor to verify the accuracy of costs. This right of audit will extend for three years after final completion, and the Contractor will maintain records reflecting all costs for this period and promptly provide access to the Owner upon request.

2.6.1 In no event shall the Owner have control over, change of, or any responsibility for construction, means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

ARTICLE 3 – CONTRACTOR

3.2 Review of Contract Documents and Field Conditions by Contractor

3.2.2 In line 7 after "Architect" insert "and Owner" and in line 8 after "request for" insert, "design". Delete the last sentence in its entirety.

3.2.3 In line 3 after "Architect" insert, "and Owner in writing," and in line 4 after "request for" insert "design."

3.2.4 Delete the "." at the end of the paragraph and insert the following, "unless the Contractor recognized or reasonably should have recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect and Owner."

Insert new paragraphs 3.2.5, 3.2.6, 3.2.7 and 3.2.8 as follows:

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

3.2.6 "The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work complies with the Contact Documents."

3.2.7 "If, in the opinion of the Architect and Owner, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to 3.2.6, 3.2.7 and 3.12 before additional services are performed."

3.2.8 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, Contractor shall promptly, but no later than three (3) business days after having such knowledge, notify the Architect in writing, providing substantiation for the position. Any necessary changes, including substitutions of materials, shall be accomplished by appropriate Modification.

3.3 <u>Supervision and Construction Procedures</u>

3.3.2 Add the following to the end of the paragraph:

As part of that responsibility, Contractor shall enforce the Owner's alcohol-free, drug-free, tobacco and e-cig-free, and weapon-free policies and zones, which will require compliance with those policies and zones by Contractor's employees, Subcontractors, and all other persons carrying out the Contract. Contractor shall also require adequate and appropriate dress of Contractor's employees, Subcontractors, and all other persons carrying out the Contract.

As to those matters for which the Contractor has responsibility under the terms of the Agreement, the Owner shall not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors or any of their agents or employees or any other persons for whom Contractor is responsible. It is understood and agreed that the relationship of Contractor to Owner shall be that of an independent contractor. Nothing contained herein of inferable herefrom shall be deemed or construed (1) to make Contractor the agent, servant, or employee of the Owner or (2) create any partnership, joint venture or other association between Owner and Contractor. Any direction or instruction by Owner or any of its authorized representatives in respect of the Work shall related to the results the Owner desires to obtain from the Work, and shall in no way affect Contractor's independent contractor status as described herein.

Insert new 3.3.4, 3.3.5, 3.3.6, 3.3.7, 3.3.8, 3.3.9, 3.3.10, 3.3.11 as follows:

3.3.4 Contractor shall be responsible to Owner for acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under Contract Documents or other arrangements with Contractor.

3.3.5 Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on the Work, including those with respect to the safety of persons and property and their protection from damages, injury, or loss. Contractor shall promptly, but no later than 5 days, remedy damage and loss to property at the site caused in whole or in part by Contractor, its Subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts they may be liable, except for damage or loss attributable solely to acts or omissions of Owner or Architect or by anyone for whose acts either of them may be liable and not attributable to the fault or negligence of Contractor, its Subcontractor, or anyone directly or indirectly employed by them. The foregoing obligations of Contractor are in addition to Contractor's obligations under other provisions hereunder.

3.3.6 Contractor shall be responsible for inspection of portion of Work already performed under the Contract for Construction to determine that such portions are in proper condition to receive subsequent Work.

3.3.7 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 that they provide materials on time. Contractor shall coordinate its Work with that of all others on the Project, including of construction utilities.

3.3.8 Contractor shall establish and maintain bench marks and all other grades, lines, and levels necessary for the Work; report errors or inconsistencies to Owner and Architect before commencing Work; and, if applicable, review the placement of the buildings and permanent facilities on the site with Owner and Architect after all lines are staked out and before foundation Work is started. Contractor shall provide access to the Work for Owner, Architect, other persons designated by Owner, and governmental inspectors. Any encroachments made by Contractor or its Subcontractors on adjacent properties caused by construction as revealed by an improvements survey, except for encroachments arising from errors or omissions not reasonably discoverable by Contractor in the Contract Documents, shall be the sole responsibility of Contractor, and Contractor shall correct such encroachments within thirty (30) days of the improvement survey (or as soon thereafter as reasonably possible), at Contractor's sole cost and expense, either by the removal of the encroachment (and subsequent reconstruction on the Project site) or agreement with the adjacent property Owner(s) (in form and substance satisfactory to Owner in its sole discretion) allowing the encroachments to remain.

3.3.9 Contractor shall verify at the Work site the measurements indicated on the Drawings and Specifications and shall establish correctly the lines, levels, and positions for the Work and be responsible for their accuracy and proper correlation with control lines, monuments, and data, as established by surveys furnished by Owner. Work shall be erected square, plumb, level, true to line and grade, in the exact plane and to the correct elevation and/or sloped to drain as indicated. To ensure the proper execution of its subsequent Work, Contractor shall measure all Work already in place (including but not

limited to utilities and grades installed or prepared by others) and shall at once report to Architect and Owner any discrepancy between said Work and the Drawings and Specifications for the Work.

3.3.10 Any discrepancy or omission in the dimensions or elevations shown on the Drawings and Specifications or found in previous Work which may prevent accurate layout or construction of the Work, shall immediately be reported by Contractor to Owner and Architect. If Contractor performs, permits, or causes performance of any Work when Contractor knows or reasonably should have known that such discrepancy or omission exists, without first obtaining further instruction from Architect or Owner, Contractor shall bear any and all costs arising therefrom including, without limitation, the costs of correction thereof without increase or adjustment in the Contract Sum. Omissions from the Drawings or Specifications, or the mis-description of details of Work which are reasonably inferable in order to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve Contractor from performing such omitted or mis-described details of the Work, and they shall be performed as if fully and correctly set forth and described in the Drawings and Specifications, at no additional cost to Owner.

3.3.11 Contractor shall engage workers who are skilled in performing the Work, and all Work shall be performed with care and skill and in a good workmanlike manner under the full-time supervision of an approved engineer or foreman. Contractor shall be liable for all property damage, including repairs and replacements of the Work and economic losses, which proximately result from the breach of this duty. Contractor shall advise Architect:

.1 if a specified product deviates from good construction practices;

.2 if following the Specifications will affect any warranties; or

.3 any objections which Contractor may have to the Specifications.

Nothing contained in Subparagraph 1.1.3 shall alter the responsibilities established in this Subparagraph.

3.4 Labor and Materials

3.4.2 At the end of the paragraph delete the "." and insert the following, "by making requests for substitutions based on Subparagraph 3.4.2, Contractor:

.1 represents that Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

.2 represents that Contractor will provide the same warranty for the substitution that Contractor would for that specified;

.3 certifies that the cost data presented is complete and includes all related

costs under this Contract except Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and

.4 will coordinate the installation for the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

Add the following at the end of the paragraph: "Contractor shall bear the risk of any delay in performance caused by submitting substitutions."

3.4.3 At the end of the paragraph insert the following, "Contractor shall also be responsible for labor peace on the Project and shall at all times make its best efforts and judgments as an experienced Contractor to adopt and implement policies and practices designed to avoid Work stoppages, slowdowns, disputes, or strikes where reasonably possible and practical under the circumstances and shall at all times maintain Project-wide labor harmony. Except as specifically provided in Subparagraph 8.3 hereof, Contractor shall be liable to Owner for all damages suffered by Owner."

Insert new 3.4.4, 3.4.5, 3.4.6 and 3.4.7 as follows:

3.4.4 Materials shall conform to manufacturer's standards in effect at the date of execution of the Agreement and shall be installed in strict accordance with manufacturer's directions. Contractor shall, if required by Owner or Architect, furnish satisfactory evidence as to the kind and quality of any materials. All packaged materials shall be shipped to the site in the original containers clearly labeled, and delivery slips shall be submitted with bulk materials identifying thereon the source, and warranting quality and compliance with Contract Documents.

3.4.5 When the Contract Documents require the Work, or any part of same, to be above the standards required by applicable laws, ordinances, rules and regulations, and other statutory provisions pertaining to the Work, such Work shall be performed and completed by Contractor in accordance with the Contract Documents.

3.4.6 When the manufacturer's name, patent numbers, underwriter's labels, model numbers or similar identifying marks are required, such markings shall be located as inconspicuously as possible.

3.4.7 Contractor agrees that it and its agents and employees will comply with the Immigration Reform and Control Act of 1986, as amended by the Immigration Act of 1990, or any subsequent legislation which regulates the employment of aliens. Contractor will not knowingly employ or knowingly allow any of its Subcontractors to employ, any illegal or undocumented aliens to perform any Work in connection with the Project. Contractor will retain and make available for inspection by Owner at the Contractor's Primary place of business on the first day of employment or upon reasonable notice, a completed I-9 Employment Eligibility Verification Form and copies of associated employment eligibility and identity documentation for each person that Contractor directly employs on the jobsite. If Contractor receives actual knowledge of

the unauthorized status of one of its jobsite employees, or if Contractor learns of facts that would lead a reasonable person to infer the unauthorized status of any jobsite employee, Contractor will immediately remove that employee from the jobsite, inform Owner, and shall require such Subcontractor to act in a similar fashion with respect to such Subcontractor's employees. Contractor agrees to have a provision on its subcontracts stating that each Subcontractor will have the duties and responsibilities with regard to its employees that the Contractor has agreed to in this section. The Contractor agrees to defend (at Owner's option, and with counsel acceptable to Owner), indemnify and hold harmless the Owner as to any fines or other liabilities of any kind arising out of or relating to Contractor's breach of this section or any immigration laws or regulations.

3. 5 Warranty

3.5.1 In line 2, delete "good" and substitute "the best". In line 4 delete "except for those inherent in the quality of the Work that Contact Documents require or permit." Delete the fourth sentence in its entirety. In the line 8 after "Architect" add "or Owner".

At the end of paragraph 3.5.2 insert the following:

ALL WARRANTIES SHALL INCLUDE LABOR AND MATERIALS AND THE MANUFACTURER'S WARRANTY SHALL BE SIGNED BY SUBCONTRACTOR AND COUNTERSIGNED BY CONTRACTOR. ALL WARRANTIES SHALL BE ADDRESSED TO OWNER AND DELIVERED TO ARCHITECT UPON COMPLETION OF THE WORK AND BEFORE OR WITH THE SUBMISSION OF REQUEST FOR FINAL PAYMENT.

Insert new 3.5.3, 3.5.4, 3.5.5, 3.5.6, 3.5.7, 3.5.8, 3.5.9 and 3.5.10 as follows:

3.5.3 Contractor shall issue in writing to Owner as a condition precedent to final payment a "general warranty" reflecting the terms and conditions of this Paragraph 3.5 for all Work under the Contract.

3.5.4 The warranties provided in Section 3.5 shall be in addition to and not in limitation of any other warranty or remedy required by law or by the Contract Documents, and such warranty shall be interpreted to require Contractor to replace defective materials and equipment and re-execute defective Work which is disclosed to the Contractor by the Owner within a period of one (1) year after Substantial Completion of the entire Work unless a longer time is specifically called for in the specifications. The Contractor shall assign all components, equipment and fixture warranties to the Owner and will deliver all manuals to the Owner at the completion of construction.

3.5.5 Except when a longer warranty time is specifically called for in the Specification Sections or is otherwise provided by law, the General Warranty shall be for twelve (12) months and shall be in form and content otherwise satisfactory to Owner.

3.5.6 Warranties shall become effective on a date established by Owner and Architect in accordance with the Contract Documents. This date shall be the Date of Substantial Completion of the entire Work, unless otherwise provided in any Certificate of Partial Substantial Completion approved by the parties.

3.5.7 If Architect considers it impractical, because of unsuitable test conditions or some other factors, to execute simultaneous final acceptance of all equipment, portions of the installation may be certified by Architect for final acceptance, subject to Owner's approval, when that portion of the system is complete and ready for operation as called for under Subparagraph 9.8.1.

3.5.8 Contractor shall warrant for a period of twelve (12) months that the building(s) shall be watertight and leak proof at every point and in every area, except where leaks can be attributed to damage to the building(s) by external forces beyond Contractor's control. Contractor shall, immediately upon notification by Owner of water penetration, determine the source of water penetration and, at its own expense, do any Work necessary to make the building(s) watertight. Contractor shall also, at its own expense, repair or replace any other damaged material, finishes, and furnishings, damaged as a result of this water penetration, to return the building(s) to its (their) original condition.

3.5.9 In addition to the foregoing stipulations, Contractor shall comply with all other warranties referred to in any portions of the Contract Documents or otherwise provided by law or in equity, and where warranties overlap, the more stringent requirement shall govern.

3.5.10 If for any reason Contractor cannot warrant any part of the Work using material or construction methods that have been specified, or shown, it shall notify Owner and Architect in writing before the Contract is signed, giving reasons, together with the name of product and data on a substitution it can warrant.

3.6 Taxes

Add the following paragraph:

The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects. No sales taxes shall be paid or charged to Owner by Contractor, subcontractors, materialmen or tradesmen.

3.7 Permits, Fees, Notices and Compliance with Laws

3.7.1 Delete entire section and replace with: Reference below sections for list of permits and fee payments.

a. Building Permit: Owner will make building permit application and pay directly

to the City and plan review fees and building permit fees. The contractor shall be responsible for obtaining the approved permit and associated drawings from the City including any requirements for licensing or name change.

b. Permanent Tap and Impact Fees: All permanent tap and impact fees assessed by the City for water, sewer, storm sewer, driveway curb cuts, streets and traffic shall be paid by the Owner directly or by the Contractor through funds included in the Construction Contingency Allowance. The Contractor shall be responsible for applying for and obtaining any tap and impact permits. Permanent fees shall be those required for the permanent Work and shall not include any tap or impact fees required by the Contractor to complete their Work or any fees associated with temporary conditions due to phasing requirements.

c. Permanent Service Provider Work and Fees: All electric and gas service provider fees associated with bringing permanent power and permanent gas service from the distribution line to the transformer and or to the gas meter, including the transformer and gas meter themselves shall be paid for by the Contractor through funds included in the Contingency Allowance. The Contractor shall be responsible for contacting, coordinating, scheduling, obtaining any required forms (including those requiring Owner's signature), and coordination of the Service Provider's Work. The Contractor shall be responsible for the Work required to facilitate the Service Provider's Work, including but not limited to: transformer and meter mounting pads, removing trees, fences, grading, site preparation or other site items required for installation. The Contractor shall be responsible for any costs associated with obtaining non-permanent power or gas required for their Work or any Subcontractor's Work to maintain the project schedule.

d. Energy and Accessibility Work and Fees: The Owner shall be responsible for paying any Energy or Accessibility review fees and or Energy or Accessibility Inspection fees. If the Contractor constructs accessibility items that are not in accordance with those designed in the Construction Documents, the Contractor shall be responsible for any Energy or Accessibility inspection fees associated with non-compliant Work or the result of the Work not being ready for Inspection when called. The Contractor will not be responsible for cost of Work or inspection fees if the accessibility items shown in the Construction Documents are not compliant with Accessibility codes or rules.

e. Miscellaneous Permits, Work and Inspection Fees: The Contractor shall be responsible for any and all state and local authorities' inspection fees. The Contractor shall be responsible for applying, obtaining and paying any and all fees associated with any Work not listed above in items a. through d. This shall include but not limited to: fire alarm, fencing & gates, security, fire sprinkler, lawn sprinkler, mechanical, electrical, plumbing, paving permits, temporary utilities or temporary taps, construction trailer, moving, additional building component permits or reviews for canopies, bleachers, cold-formed metal framing, 3-way contracts, etc.

f. SWPPP Plans: The Contractor shall also obtain all permits and approvals, and pay all fees and expenses, if any, associated with National Pollutant Discharge

Elimination System (NPDES) regulations administered by the Environmental Protection Agency and state and local authorities, that require completion of documentation and/or acquisition of all permits for the Project. Contractor's obligations under this paragraph do not require it to perform engineering services during the pre-construction phase to prepare proper drainage for the construction sites. However, any drainage alterations made by Contractor during construction phase which modifies the original site drainage plan and requires the issuance of a permit shall be at Contractor's sole cost. The Owner shall pay directly to the governing authority the cost of all permanent property utility assessments and similar utility connection charges.

3.7.2 In line 2 after "lawful orders" insert "and all other requirements".

3.7.3 In line 1 after "Work" insert, "(including, without limitation, the installation of any materials or equipment) that it knows or reasonably should have known would" and also in line 1 delete "knowing it to be"

3.7.4 In line 8 after "will recommend" insert "to the Owner in writing,". At the end of the paragraph insert the following, "No adjustment in the Contract Time or Contract Sum shall be permitted in connection with a concealed or unknown condition that does not differ materially from those conditions disclosed or based on data provided to Contractor and by the Contractor's prior inspections, tests, reviews, and pre-construction services for the Project; or by the Contractors inspections, tests, reviews and pre-construction services that Contractor had the opportunity and obligation to make in connection with the Project but did not do so.

3.7.5 In line 3 after "Owner and Architect" insert "in writing".

Insert new 3.7.6 as follows:

3.7.6 The Contractor shall comply with the provisions of Section 22.08341 of the Texas Education Code and Section 153.1117 of the Texas Administrative Code. The form of certification by the Contractor shall be supplied by the Owner and must be supplemented by the Contractor as required by law, or as requested by the Owner.

3.8 Allowances

3.8.3 At the end of the sentence insert the following, "If a decision is needed to avoid a delay, Contractor shall notify Architect and Owner in writing sufficiently in advance of needed date to allow reasonable time for selections to be made."

3.9 Superintendent

3.9.2 Delete the second and third sentences in their entirety and insert the following in lieu thereof, "The Superintendent shall be satisfactory to the Owner and shall not be changed except with the consent of the Architect, unless the Superintendent leaves the employment of the Contactor. No increase in Contract Time or Contract Sum shall be

allowed in the event the Owner or Architect objects to any nominated superintendent. Such approval by the Owner shall not be unreasonably withheld."

3.9.3 Delete in its entirety and replace with the following:

3.9.3 Superintendent shall become resident on the site as soon as possible after commencement of the Work, and shall remain assigned to this Work, and resident on the site, throughout the course of the Work until items requiring completion or correction, identified at Substantial Completion, have been completed or corrected. A "resident on the site" is a person/worker who maintains his office and work area on the site and remains available to those working on site or visiting the site.

Insert new 3.9.4 and 3.9.5 as follows:

3.9.4 Project manager, while not required to be resident on the site, shall remain assigned to this Work, and be available on an as-needed basis throughout the course of the Work until items requiring completion or correction, identified at Substantial Completion, have been completed or corrected.

3.9.5 Owner shall be notified not less than 24 hours before any time superintendent will not be resident at the site for any reason except periodic illness; if the reason is due to illness, Owner shall be notified at the beginning of that day. Owner shall be notified of the identity of the acting superintendent. In the event the superintendent is absent from the site and notice has not been provided nor has an acting superintendent been assigned to the Work, then the Contractor is subject to being backcharged in the amount of $250.00 for each occurrence.

3.10 <u>Contractor's Construction and Submittal Schedules</u>

3.10.1 Delete the last sentence and add: "The schedule shall be updated every thirty (30) days and submitted to Architect with Contractor's Applications for Payment. Each schedule shall contain a comparison of actual progress with the estimated progress for such point in time stated in the original schedule. If any schedule submitted sets such a date for Substantial Completion for the Work or any phase of the Work beyond the date(s) of Substantial Completion established in the Contract (as the same may be extended as provided in the Contract Documents), then Contractor shall submit to Architect and Owner for their review and approval a narrative description of the means and methods that Contractor intends to employ to expedite the progress of the Work to ensure timely completion of the various phases of the Work as well as the totality of the Work. To ensure such timely completion, Contractor shall take all necessary action including, without limitation, increasing the number of personnel and labor on the Project and implementing overtime and double shifts. In that event, Contractor shall not be entitled to an adjustment in the Contract Sum or the schedule."

3.10.2 In line 2 after "for the Architect's" insert "and Owner's". In line 3 after "Architect's" insert "and Owner's"

Insert new 3.10.4, 3.10.5 and 3.10.6 as follows:

3.10.4 The process of approving Contractor's schedules and updates to Contractor's schedule shall not constitute a warranty by the Owner that any non-Contractor milestones or activities will occur as set out on Contractor's schedule. Approval of a Contractor's schedule does not constitute a commitment by the Owner to furnish any Owner-furnished information or material any earlier than Owner would otherwise be obligated to furnish that information or material under the Contract Documents. Failure of the Work to proceed in the sequence scheduled by Contractor shall not alone serve as the basis for a Claim for additional compensation or time. In the event there is interference with the Work, which is beyond its control, Contractor shall attempt to reschedule the Work in a manner that will hold resulting additional time and cost to a minimum. The construction schedule shall be in a detailed format satisfactory to the Owner and the Architect and shall also:

.1 Provide a graphic representation of all activities and events that will occur during performance of the Work;
.2 identify each phase of construction and occupancy; and
.3 set forth dates that are critical in ensuing the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents hereinafter referred to as Milestone Dates.

3.10.5 The Owner shall have the right to reschedule the time of day for the performance of any part of the Work that may interfere with the operation of the Owner's premises or any tenants or invitees thereof. The Contractor shall, upon the Owner's request, reschedule any portion of the Work affecting operation of the premises during hours when the premises are not in operation. Any rescheduling of performance of the Work under this Subparagraph 3.10.5 may be grounds for an extension of the Contract Time, if permitted under Subparagraph 8.3.1 and an equitable adjustments in the Contract Sum, if: (1) the performance of the Work was properly scheduled by the Contractor in compliance with the requirements of the Contract Documents, (2) such rescheduling is required for the convenience of the Owner and is not attributable to any act or omission of Contractor, and (3) if Owner agrees to the Contract Sum adjustment prior to any rescheduling.

3.10.6 If the project is behind schedule, Contractor shall submit a "Recovery Plan" which will indicate the manner in which Contractor intends to get the Work back on schedule. Owner may require Contractor to take efforts to expedite progress of the Work in conformance with the progress anticipated by the schedule, which actions may include without limitations, increasing the number of workmen performing the Work, utilizing overtime work and requiring additional work shifts. In the event of such unexcused Project delays, any extra costs incurred by the Contractor to place the Project back on schedule shall be at Contractor's sole expense.

3.11 Documents and Samples at the Site

Insert new 3.11.1 and 3.11.2 as follows:

3.11.1 At the Date of Substantial Completion and as a condition precedent to final payment, Contractor shall furnish the following documents to Architect for submittal to Owner: Record Drawings showing the field changes and selections (all changes and selections to be approved by Owner and Architect in advance) affecting the general construction, mechanical, electrical, plumbing, and all other Work, and indicating the Work as actually installed. These shall consist of carefully drawn markings on a set of reproducible prints of Architect's Drawings obtained and paid for by Contractor. Contractor shall maintain at the job site one (1) set of Architect's Drawings and indicate thereon each field change as it occurs. The Contractor shall post all Addenda on Construction Documents prior to commencing work on the site.

3.11.2 Contractor shall at all times maintain job records, including, but not limited to, invoices, payment records, payroll records, daily reports, logs, diaries, and job meeting minutes, applicable to the project. Contractor shall make such reports and records available to inspection by the Owner, Architect, or their respective agents, within five (5) working days of request by Owner, Architect, or their respective agents.

3.12 Shop Drawings, Product Data and Samples

3.12.5 At the end of the paragraph insert the following, "If, in the opinion of the Architect, the Shop Drawings, Product Data, Samples and similar submittals are incomplete, indicate an inadequate understanding of the work covered by the submittals, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the submittals will be returned, unchecked, to the Contractor for correction of these three deficiencies and subsequent re-submittal. Additional service charges as outlined in 3.2.7 may be charged by the Architect in this event.

3.12.10.1 In line 6 after "design professional" insert "and who shall comply with requirements of Owner regarding qualifications and insurance and".

Insert new 3.12.11 as follows:

3.12.11 The Contractor shall submit Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. Where colors are to be selected by the Architect, the Contractor shall submit all Samples in adequate time to allow the Architect to prepare a complete selection schedule. In general, all submittals requiring color selection shall be submitted to the Architect within four weeks of the date of the Contract for construction.

3.13 Use of Site

Insert new 3.13.1, 3.13.2, 3.13.3 and 3.13.4 as follows:

3.13.1 Only materials and equipment which are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Project site but in no event shall the equipment be left on the Property longer than two (2) days after its completed use. Protection of construction materials and equipment stored at the Project site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.13.2 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without written consent of the Owner.

3.13.3 Contractor shall ensure that the Work, at all times, is performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision on the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of: (1) any area and buildings adjacent to the site or the Work or (2) the Building in the event of partial occupancy.

3.13.4 Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including without limitation, lavatories, toilets, entrance and parking areas other than those designated by Owner. Without limitation of any other provisions of the Contract Documents, the Contractor shall use its best efforts to comply with all rules and regulations promulgated by the Owner in connection with the use and occupancy of the Project site and the Building, as amended from time to time.

3.15 <u>Cleaning Up</u>

Insert new 3.15.3 as follows:

3.15.3 Prior to the Architect's inspection for Submittal Completion the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; replace air filters in mechanical equipment; clean roof, gutters and downspouts; remove obstructions and flush debris from drainage systems; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

Delete Section 3.18 in its entirety and replace with the following:

§ 3.18 INDEMNIFICATION, ACKNOWLEDGEMENT OF LIMITED LIABILITY, ETC.

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner and its directors, officers, agents and employees (the "Indemnitees") from and against claims, damages, losses and expenses, including without limitation, attorney's fees, arising out of or relating to the Work of this Contract, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease, or death, or injury to or destruction of tangible property (other than the Work itself), including loss of use resulting therefrom, to the extent such claim, damage, loss or expense is caused, in whole or in part, by the negligence or fault, strict liability, breach or violation of a statute, ordinance, governmental regulation, standard, or rule, or breach of contract by any person or entity other than the Indemnitees, including that of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable.

§ 3.18.2 To the fullest extent permitted by law, and in addition to the indemnity obligation under Section 3.18.1, the Contractor shall indemnify and hold harmless the Indemnitees from and against claims, damages, losses and expenses, including without limitation, attorney's fees, arising out of or relating to the Work of this Contract, provided that such claim, damage, loss or expense is attributable to bodily injury or death of the Contractor, a Subcontractor of any tier, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable.

§ 3.18.3 In the event of any claim alleging partial, contributory, concurrent, or joint wrongful conduct of the Indemnitees that is not covered under the Contractor's indemnity obligations under Section 3.18.2, the Contractor shall be obligated to reimburse the Owner for its reasonable attorneys' fees in proportion to the Contractor's liability, as such may be agreed to by the Contractor or found by a trier of fact.

§ 3.18.4 The defense, indemnity and reimbursement obligations in Sections 3.18.1, 3.18.2, and 3.18.3 shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to the party or persons described in this Section 3.18, or elsewhere in the Contract Documents. These defense, indemnity and reimbursement obligations shall not be limited by any limitation on the amount or type of compensation, benefits or damages payable by or for the Contractor under any workers' compensation or other benefits laws, or by the limits of any insurance of the Contractor. These defense, indemnity and reimbursement obligations shall survive completion of the Work or early termination of the Contract.

§ 3.18.5 The Contractor acknowledges that the Owner shall have no obligation to supervise performance of the Work or Work Site for safety, nor does the Owner exercise any control over the means and methods of construction employed by the

Contractor, Subcontractor of any tier, or anyone directly or indirectly employed by them. The Contractor further acknowledges that the Owner's liability for claims of personal injury, death, or property damage are limited by Section 95.003 of the Texas Civil Practice and Remedies Code, as well as the privileges and immunities enjoyed by Owner as a governmental unit of the State of Texas.

§ 3.18.6 The Contractor shall provide workers' compensation insurance coverage for each employee of the Contractor employed on the Project, and shall require the same of its Subcontractors of any tier. The Contractor and each Subcontractor of any tier shall be required to provide certificates of this coverage to the Owner. The foregoing indemnification obligations shall not be limited in any way by limitations on the amount or type of damages, compensation or benefits payable under workers' compensation acts, disability benefits acts or other employee benefits acts.

§ 3.18.7 To the extent any of the obligations in this Section 3.18 violate applicable law, the obligation(s) will be reformed or severed to the minimum extent necessary to comply with applicable law in order to provide the maximum protection to the Indemnitees.

§ 3.18.8 The Contractor's defense, indemnity and hold-harmless obligations under this Agreement shall survive completion of the Work or early termination of the Agreement.

Insert new 3.19, 3.19.1 and 3.19.2 as follows:

3.19 Substitutions of Products and Systems, "Or Equal" Brands

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

3.19.2 If, after award of contract, the Contractor or one of his Subcontractors or Suppliers determines that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Contractor shall promptly, but no later than two days after such determination, notify the Architect, in writing, providing detailed substantiation for his position. Any changes deemed necessary by the Owner and Architect, including substitution of materials and change in Contract Sum, either upward or downward, if any, shall be accompanied by appropriate modification.

Insert new 3.20 and 3.20.1 as follows:

3.20 Record Drawings

3.20.1 At the completion of the project, the Contractor shall submit one complete set of blue lines showing all changes and routing of utilities made during construction, excluding Architect made CAD changes, to the Architect. Drafting shall be legible to the Architect's satisfaction. The Contractor shall pay for the cost of the required recording/drafting. The record set shall be kept up to date on a daily basis and the Architect shall review its status at the project meetings. The Architect shall furnish the Contractor with a blueline set at contract award which shall have all Addenda incorporated. The Owner will pay for the printing of the blueline set. The Architect will incorporate any record information into the construction (CAD) documents and provide the Owner with an electronic copy of the record information on the Construction documents that have all bid and construction changes incorporated. The cost for incorporating the record information into the CD will be paid for by the Owner. The Architect will transmit the electronic CD to the Owner with a copy of the transmittal to the Contractor's construction manager.

ARTICLE 4 – ARCHITECT

4.1 General

4.2 Administration of the Contract

4.2.3 Delete the last two sentences in their entirety and insert "Architect shall not have control over or charge of and shall not be responsible for safety precautions and programs in connection with the Work. Architect shall be responsible for immediately notifying Contractor of the failure of Contractor, Subcontractors or any other persons performing any of the Work, in failing to use proper construction means, methods, techniques, sequences, procedures, safety precautions and programs, but only to the extent Architect becomes aware of, or should, exercising due professional diligence, be aware of, same. Architect shall also immediately notify Owner in writing of the failure of any of the foregoing parties to carry out the Work in accordance with the Contract Documents."

4.2.7 In line 1, after "approve" insert "or reject,". In line 2, delete "but only for the limited purpose of checking".

4.2.12 Delete the last sentence in this paragraph.

4.2.13 Delete paragraph in its entirety.

ARTICLE 5 – SUBCONTRACTORS

5.1 Definitions

5.1.1 In line 2, after “site” delete “.” and insert “or to otherwise furnish labor, material, or other services with respect to a portion of the Work.”

5.1.2 In line 2, after “site” delete “.” and insert “or to otherwise furnish labor, material, or other services with respect to a portion of the Work.”

5.3 Subcontractual Relations

Insert new 5.3.1 as follows:

5.3.1 All subcontracts shall be in written form.

5.4 Contingent Assignment of Subcontracts

Add at the end of 5.4.1

“Such assignment shall not constitute a waiver by Owner of its rights against Contractor because of defaults, delays and defects for which a Subcontractor or material vendor may also be liable. Contractor indemnifies and holds Owner harmless from any failure or refusal of any Subcontractor to comply with any provision of the Contract Documents.”

5.4.3 Delete the second sentence in its entirety.

Insert new paragraph 5.5 as follows:

5.5 Contractor shall immediately notify Owner and Architect of any material defaults by any Sub-contractor. Notwithstanding any provision contained in Article 5 to the contrary, it is hereby acknowledged and agreed that Owner has in no way agreed, expressly or implicitly, nor will Owner agree, to allow any Sub-contractor or other materialman or workman employed by Contractor the right to obtain a personal judgment or to create a lien against Owner for the amount due from the Contractor.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTOR

6.2 Mutual Responsibility

6.2.3 Delete in its entirety.

6.2.4 In line 1 delete “wrongfully”.

ARTICLE 7 – CHANGES IN THE WORK

7.1 General

7.1.1 In line 1, before “be” add “only”.

7.1.2 In Line 2, delete “and” after the word “Owner” and insert “and/or”. In line 3, replace the words “Architect alone” with “Owner or the Architect subject to the approval of Owner”.

7.1.3 At the end of the paragraph insert “Except as permitted in Paragraph 7.3 and 9.7, a change in the Contract Sum or the Contract Time shall be accomplished only by Change Order. Accordingly, no course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work and no claim that Owner has been unjustly enriched by any alteration of or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim to an increase in any amounts due under the Contract Documents or a change in any time period provided for in the Contract Documents.”

7.2 Change Orders

Insert new 7.2.2, 7.2.3, 7.2.4, 7.2.4.1, 7.2.5, 7.2.5.1, 7.2.5.1.1, 7.2.5.1.2, 7.2.5.1.3, 7.2.5.1.4 and 7.2.5.2 as follows:

7.2.2 Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited, to all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum and the construction schedule.

7.2.3 Contractor shall keep and periodically submit to Owner copies of a log for all Change Orders.

7.2.4 Changes in the Work: The Owner, without invalidating the Contract and without approval of the surety, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions. The Contractor may recommend and propose changes in the Work to be considered by the Owner. The Contract Sum and the Contract Time will only be adjusted in accordance by Change Orders processed and approved by the Owner.

7.2.4.1 No written order or oral order from the Owner (which terms as used in this paragraph shall include direction, instruction, interpretation, or determination) which fails to address Contract Time or Contract Sum shall be treated as a change in the Contract which affects the Contract Time or the Contract Sum unless the Contractor gives the Owner written notice within ten (10) days of such written or oral order stating the date, circumstances, source of the order and that the Contractor regards the order to be a change in the Contract which affects the Contract Time or the Contract Sum. Except as provided above, no order, oral statement, or direction of the Owner shall be treated as a change in the Work to be addressed by a Change Order or entitle the Contractor to an adjustment in the Contract Time or the Contract Sum.

7.2.5 Change Proposals: The Contractor shall review and respond to all requests for a Change Proposal submitted by the Architect in accordance with the following:

7.2.5.1 In responding to a request for a Change Proposal, the Contractor shall furnish a lump sum proposal supported by a complete breakdown as described hereafter and satisfactory to the Owner indicating the total estimated cost for performance of the changed Work including the applicable percentage for overhead and profit. To permit evaluation by the Owner, any request for a time extension must be justified and presented in adequate detail, showing that the proposed change will cause a delay in meeting one or more Milestones. The contractor shall make all reasonable efforts to rearrange the work to avoid time extensions. Any extension that may be approved shall be net of any delays caused by or due to the fault or negligence of the Contractor or which are otherwise the responsibility of the Contractor and shall be also net of any contingency or "float" time in the Project Schedules.

7.2.5.1.1 The Contractor 's cost proposal given in response to a request for a Change Proposal shall, unless otherwise consented to in writing by the Owner, contain the following items for changed Work performed directly by the Contractor or performed by a Subcontractor:

a) Estimated cost, using any discounts to the trades, of the materials and supplies used, which shall be itemized completely to include unit cost, quantity and total cost.

b) Estimated wages paid for labor performing the additional Work, which shall be itemized completely to include for each trade and skill level the hourly rate, total hours and total cost. Such wages shall include labor required for performance of the changed Work only. Crew foremen may be included. All other supervisors shall be excluded and shall be considered as a part of the Overhead Markup.

c) Estimated cost for construction equipment used on the changed Work, to include rental rates or owned equipment rates for such items of equipment while in use directly on the changed Work covered by the Change Proposal,

which shall be itemized completely to include type(s), the number(s) of each, hourly rate, hours, total cost and state sales tax paid. Rental or owned equipment rates shall be no greater than those established by market conditions for the local area. As used herein the terms “construction equipment” and “equipment” shall include wheeled vehicles and tools. The Owner retains the right of purchase or lease purchase if cumulative rental costs make this an economically sound option.

d) Estimated reasonable transportation costs for delivery and handling of materials, additional construction equipment, and/or new items of installed equipment, if applicable, which shall be itemized separately.

e) Estimated off-site storage costs for periods in excess of thirty (30) calendar days, if applicable, covering protection of new items or equipment to be installed.

f) A percentage for labor burdens added to the wages computed in accordance with (b) above. Such percentage for labor burden shall be delivered in writing by the Contractor to the Owner for approval by the Owner within ten (10) days after issuance of the Notice to Proceed. This percentage shall reimburse the Contractor for the actual cost of FICA, State and Federal Unemployment Insurance, insurance computed on wages, small tools (tools having an original value of $500 or less, consumable supplies, and training and fringe benefits, if applicable. The premium portion of any overtime (which must be approved in advance by the Owner in writing) shall not include an allowance for small tools (toolshaving an original value of $500 or less), consumable supplies, training or fringe benefits.

7.2.5.1.2 In submitting the response to a Change Order Proposal, a mark-up of ten percent (10%) of the items in (a)-(f) above may be included for the Contractor or Subcontractor directly performing the changed Work covered by items (a)-(f) above. Such ten percent (10%) mark-up is intended to cover all field supervision above the level of crew foreman, field and general home office services and expenses, interference with other work or any other consequential effects, adjustments to progress schedules and all other overhead (including bond and insurance not computed on wages) and profit of the Contractor or Subcontractor directly performing the changed Work.

7.2.5.1.3 In submitting the response to a Change Order Proposal, a mark-up of five percent (5%) of any payments to a Subcontractor may be included for the Contractor and any Subcontractors which supervise the Subcontractor directly performing the changed Work. Such five percent (5%) mark-up is intended to fully reimburse the Contractor and any Subcontractor supervising the Subcontractor directly performing the changed Work for overhead expenses and profit.

7.2.5.1.4 In cases where changes in the Work performed by the Contractor with its own

forces or by a Subcontractor result in a credit (i.e., cost savings) to the Owner, the credit shall be limited to direct costs to the Contractor or Subcontractor, which include the labor burden described in paragraph 7.2.5.1.1(f) above; that is, no overhead or profit shall be credited. In cases where an individual change in the Work results in both credits and charges to the Owner, the Contractor will add the overhead and profit percentages indicated in this Section above only to the "net" charge to the Owner (i.e., based upon the amount by which the total charges exceed the total credits to the Owner).

7.2.5.2 The Contractor's response to a request for a Change Proposal shall be submitted in writing within ten (10) days after the Owner's delivery to the Contractor of the Change Proposal request, unless the Owner extends such period of time in writing. Changes in the Contract Time and/or Contract Sum will be negotiated as soon as practicable thereafter. If agreement is reached, the agreed changes will be incorporated in a Change Order and such Change Order shall be signed by the Contractor and the Owner. If (i) the Contractor fails to timely respond to a request for a Change Proposal, (ii) the Owner and the Contractor do not agree as to changes in the Contract Time or Contract Sum, or (iii) the Owner concludes that the time needed for obtaining a proposal from the Contractor and negotiating a Change Order would significantly damage the Project and/or impose significant added cost, the Owner may, at its option, issue a Unilateral Change Order without the agreement of the Contractor as to changes in the Contract Time and Contract Sum. In all events, the Contractor will diligently proceed to accomplish the Work set forth in the Change Order issued by the Owner. Contractor shall not be required to perform or subcontract work for removal, remediation, and/or transportation of hazardous materials.

7.3 Construction Change Directives

7.3.1 At the end of the paragraph insert “Contractor shall keep and periodically submit to Owner copies of a log for all Construction Change Directives and a log for all requests for information.”

7.4 Minor Changes in the Work

7.4 Substitute “Owner” for “Architect” in all sentences in this paragraph.

ARTICLE 8 – TIME

8.1 Definitions

Insert new 8.1.1.1 and 8.1.1.2 as follows:

8.1.1.1 The Work shall be fully completed within the time limit and/or date stated in the Contract between Owner and Contractor.

8.1.1.2 Liquidated Damages: If the Contractor should fail to fully complete the Work

within the stated time (subject however to extension of time duly granted in the manner and for the causes specified in the General Conditions), Contractor shall be charged by and shall pay to Owner, as liquidated damages, the sum specified in Article 3.1 of the Modified AIA document A101 – 2017 Edition per calendar day that the Work remains incomplete beyond the time fixed for completion. Contractor hereby agrees that from the nature of the project it would be impracticable and extremely difficult to fix the actual damage that would or will be suffered in the event that Contractor should fail to fully complete the Work by the time limit or date stated and the amount of the liquidated damages are fair and reasonable. The parties agree that the liquidated damages are a reasonable forecast of just compensation for the harm done to Owner that would be caused by Contractor's failure to timely complete the Work and are not a penalty. Contractor agrees that the amount of liquidated damages due Owner may be deducted by Owner from any monies that might otherwise be or become payable to Contractor.

8.3 Delays and Extensions of Time

8.3.1 At the end of the paragraph delete "." , and insert ", provided, however, that such extension of Contract Time shall be net of any delays caused by or due to the fault or negligence of Contractor or that are otherwise the responsibility of Contractor and shall also be net of any contingency or float time allowance included in Contractor's construction schedule. Contractor shall, in the event of any occurrence likely to cause a delay, cooperate in good faith with Architect and Owner to minimize and mitigate the impact of any such occurrence and do all things reasonable under the circumstances to achieve this goal."

Delete existing Article 8.3.3 and replace with the following:

Extension of time shall be Contractor's sole remedy for any such delay, unless the same shall have been caused by acts constituting intentional interference by Owner with Contractor's performance of the Work and where and to the extent that such acts continue after Contractor's notice to Owner of such interference. Owner's exercise of any of its rights under this Agreement, or Owner's exercise of any of its remedies of suspension of the Work, or requirement of correction or re-execution of any defective Work, shall not under any circumstances be construed as intentional interference with Contractor's performance of the Work.

ARTICLE 9 – PAYMENTS AND COMPLETION

9.2 Schedule of Values

9.2 In line 2 after "schedule of values to the" insert "Owner and". In line 3 delete "prepared in the form and supported by the data to substantiate its accuracy required by the Architect" and insert, "equal the total Contract Sum, divided so as to facilitate payments to Subcontractors, supported by such evidence of correctness as Architect may direct or as required by Owner. This schedule, when approved by Architect and Owner, shall be

used to monitor the progress of the Work and as a basis for Certificates for Payment. All items with entered values will be transferred by Contractor to the Application and Certificate for Payment, and shall include the latest approved Change Orders and Construction Change Directives. Change Order values and Construction Change Directives values shall be broken down to show the various subcontracts. The Application for Payment shall be on a form as provided by Architect and approved by Owner. Each item shall show its total scheduled value, value of previous applications, value of the application, percentage completed, value completed, and value yet to be completed. All blanks and columns must be filled in, including every percentage complete figure."

9.3 <u>Applications for Payment</u>

9.3.1 In line 2 delete "if required under Section 9.2" At the end of the paragraph insert "Any allowances included in the Application for Payment shall be separately itemized with supporting data attached. The Application for Payment shall be accompanied by a certification by an officer of the Contractor to the effect that:

> There are no known mechanics', materialman's or laborers' liens or claims, or any other liens or claims, legal or equitable, contractual, statutory, or constitutional, outstanding or known to exist at the date of this Application; all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current Application and there is no known basis for the filing of any mechanics', materialman's or laborers' lien or claim, or any other lien or claim, legal or equitable, contractual, statutory, or constitutional, on the Work; and waivers and releases from all Subcontractors, laborers, and material men for Work done and materials furnished have been obtained in such form as to constitute an effective waiver and release of all such liens and claims under the laws of the state within which the Project is located and shall be delivered to Architect together with Contractor's waiver and release of liens and claims at the time of submission of the Application for Payment.

Certifications shall also be submitted by all subcontractors and suppliers with each application for payment for Work performed the given payment period. "

9.3.2 In line 4 after "in writing" insert "by the Owner and Surety." At the end of the paragraph insert the following, "Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment."

9.3.3 At the end of the paragraph insert, "The vesting of such title shall not impose any obligations on Owner or relieve Contractor of any of its obligations under the Contract, that Contractor shall remain responsible for damage to or loss of the Work, whether completed or under construction, until responsibility for the Work has been accepted by Owner in the manner set forth in the Contract Documents.

9.5 Decisions to Withhold Certification

9.5.1.3 Add to the end of the sentence, “and failure to provide certifications of payment by the Contractor and its subcontractors and suppliers”

9.5.1.6 In line 1 delete “and” and insert “or”.

9.5.1.7 In line 1 delete “repeated”.

Insert new 9.5.5 as follows:

9.5.5 Notwithstanding any provision contained within this Article, if the Work has not attained Substantial Completion with the contract time, subject to extensions of time allowed under these Conditions, Architect may withhold any further payment to Contractor to the extent necessary to preserve sufficient funds to complete the construction of the Project and to cover liquidated damages assessed against Contractor up to the time of the Application for Payment and to the time it is reasonably anticipated that Substantial Completion will be achieved.

9.6 Progress Payments

9.6.1 At the end of the paragraph insert the following, “Owner may refuse to make payment on any Certificate for Payment for any default of the Contractor, including, but not limited to, those defaults set forth in Clauses 9.5.1.1 through 9.5.1.7. Owner shall not be deemed in default by reason of withholding payment while any of such defaults remain uncured.”

9.6.4 In line 5 delete “except as may otherwise be required by law.”

9.6.7 Delete in its entirety.

9.7 Failure of Payment

9.7 In line 2, after “not” add “, for reasons other than a default of the Contract, including, but not limited to, those defaults set forth in Clauses 9.5.1.1 through 9.5.1.7". In line 3 delete “or awarded by binding dispute resolution”.

Insert new 9.7.1 as follows:

9.7.1 If Owner is entitled to reimbursement or payment from Contractor under or pursuant to the Contract Documents, such payment shall be made promptly upon demand by Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if Contractor fails to promptly make any payment due Owner, or if Owner incurs any costs and expenses to cure any default of Contractor or to correct defective Work, Owner shall have an absolute right to offset such amount against the Contract Sum and may, in Owner’s sole discretion, elect either to (i) deduct an amount equal to that which Owner is

entitled from any payment then or thereafter due Contractor from Owner, or (ii) issue a written notice to Contractor reducing the Contract Sum by an amount equal to that which Owner is entitled.

9.8 <u>Substantial Completion</u>

9.8.1 In line 1 after "thereof" add "(which Owner agrees to accept separately)".

9.8.4 In line 5, delete "Substantial Completion of the Work or designated portion thereof" and substitute "issuance of the certificate of final payment by Architect". At the end of the paragraph insert "The Work will not be considered suitable for Substantial Completion review until all Project systems included in the Work are operational as designed and scheduled, all designated or required governmental inspections and certifications have been made and posted, designated instruction of Owner's personnel in the operation of systems has been completed, and all final finishes within the Contract are in place. In general, the only remaining Work shall be minor in nature, so that Owner and/or Owner's employees and if applicable, the public, could occupy the building on that date and the completing of the Work by Contractor would not materially interfere or hamper Owner's or Owner's employees and if applicable, the public, (or those claiming by, through, or under Owner) normal school operations. As a further condition of Substantial Completion acceptance, Contractor shall certify that all remaining Work will be completed within thirty (30) consecutive calendar days or as agreed upon following the Date of Substantial Completion. If Contractor requests a Substantial Completion review, and Architect, after performing the Substantial Completion review, finds that the Project was not ready for the Substantial Completion review, then Contractor shall pay the Architect's fees for any additional Substantial Completion reviews."

Insert new 9.8.6 and 9.8.7 as follows:

9.8.6 In order for the project or a major portion thereof to be considered substantially complete, the following conditions must be met: (1) All inspections by governmental authorities which have jurisdiction over the project must have been finalized, any remedial work required by those authorities must have been completed, and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect. (2) All work, both interior and exterior, shall have been completed and cleaned except minor items which if completed after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.

9.8.7 After the date of Substantial Completion of the Project is evidenced by the Certificate of Substantial Completion, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to correct all deficiencies attached to the Certificate of Substantial Completion. Failure of the

Contractor to complete such corrections within the stipulated time will be reported to the Contractor's surety. In this report, the Contactor and surety will be informed that, should correction remain incomplete for fifteen (15) days, the Owner may initiate action to complete corrective work out of the remaining Contract funds in accordance with Article 14.

9.10 Final Completion and Final Payment

9.10.2 Add at the end of the first sentence "(7) Record Drawings, and (8) Maintenance and instruction Manuals, three sets bound in a 3" ring binder."

9.10.4 Add at the end ".5 faulty or defective Work appearing after Substantial Completion."

ARTICLE 10 – SAFETY OF PERSONS AND PROPERTY

10.2 Safety of Persons and Property

10.2.3 At the end of the paragraph insert "The Contractor shall also be responsible, at the Contractor's sole cost and expense, for all measures necessary to protect any property adjacent to the project and improvements therein. Any damage to such property or improvements shall be immediately repaired by the Contractor."

10.3 Hazardous Materials

10.3.3 Delete paragraph in its entirety.

10.3.4 In the first sentence after "brings to the site" insert "." Delete the remainder of the paragraph.

10.3.6 Delete paragraph in its entirety.

Add the following at the end of 10.4

"; provided the Contractor shall not be entitled to additional compensation or an extension of time if an emergency is caused by the negligence or failure to fulfill a specific responsibility of the Contractor to the Owner set forth in the Contract Documents or the failure of the Contractor's personnel to supervise adequately the Work of the Subcontractors or suppliers."

ARTICLE 11 – INSURANCE AND BONDS

11.1 Contractor's Liability Insurance

Insert new 11.1.1.2 through 11.1.1.6.5 as follows:

11.1.1.2 SCHEDULE OF INSURANCE COVERAGES

11.1.1.2.1 Contractor shall carry and keep in full force for the duration of the project the following Coverage.

Coverage	Amounts and Limits
Worker's Compensation	Statutory Limits
Employer's Liability:	
Bodily Injury by Accident	$1,000,000/each accident
Bodily Injury by Disease	$1,000,000/each employee
Bodily Injury by Disease	$1,000,000/Policy Limit
Commercial General Liability	
Bodily Injury/Property Damage	$1,000,000.00 per occurrence $2,000,000.00 aggregate

(Premises Operations, Independent Contractors, Product/Completed Operations, Personal Injury, Contractual Liability, Explosion, Collapse, Underground and Broad Form Property Damage).

Comprehensive Automobile Liability	$1,000,000.00 Combined Single Limit per Occurrence

Auto liability insurance shall be on a standard form written to cover all owned, hired, and non-owned automobiles. The policy shall be endorsed to include the Indemnitees (Section 3.18) as additional insured, and state that this insurance is primary insurance as regards to any other insurance carried by the Indemnified Parties (see Section 3.18).

11.1.1.2.2 All policies shall contain special endorsements to include:

.1 The Owner as an additional insured (except for Worker's Compensation) and all other parties identified in Section 3.18 (Indemnitees);

.2 Wavier of Subrogation in favor of Owner under the Worker's Compensation and Employer's Liability policies.

.3. A statement that a notice shall be given to Owner by certified mail fifteen (15) days prior to cancellation or upon any material changes in coverage.

.4 Contain cross-liability and severability of interest endorsements;

.5 state that this insurance is primary insurance in regard to any other insurance carried by the indemnified Party (see 3.18));

.6 the following coverage:

a. Premises/Operations;
b. Independent Contractors;
c. Completed Operations following the acceptance of Contractor's Work;
d. Comprehensive General Liability Endorsement to include Blanket Contractual Liability (specifically covering, but not limited to, the contractual obligations assumed by Contractor, Broad Form Property Damage, and Personal Injury Liability with employee and contractual exclusions removed);
e. Deletion of exclusions relative to Collapse, Explosion, and Underground Property Damage Hazards;
f. Personal Injury Liability with the contractual exclusions removed;
g. Cross Liability Endorsement.

11.1.1.3 <u>Umbrella Excess Liability Insurance</u>

Bodily Injury and	$10,000,000 per occurrence
Property Damage	$10,000,000 aggregate

This policy shall be written on an umbrella excess basis above, the coverage described in this Article 11. The policy shall be endorsed to include the Indemnified Parties (3.18) as additional named insureds. The policy shall contain cross-liability and severability of interest endorsements and shall state, as regard the Indemnified Parties that the insurance is primary insurance as to any other insurance carried by any Indemnified Party. The policy shall be endorsed to provide the defense coverage obligation. Insurance carried by the Contractor shall be with insurers having Best's Rating of A-V or better.

11.1.1.4 Further, Contractor shall require all Subcontractors to carry similar insurance coverage and limits of liability as required under this Article 11 related to Worker's Compensation, Commercial Liability and Comprehensive Automotive, adjusted to the nature of Subcontractor's operations before any Work commences.

11.1.1.5 In the event Contractor fails to obtain the required certificates of insurance from the Subcontractor and a claim is made or suffered, Contractor shall indemnify, defend, and hold harmless the indemnified parties from any and all claims for which the required insurance would have provided coverage.

11.1.1.6 <u>Performance Bond and Payment Bond</u>

11.1.1.6.1 The Contractor shall furnish a Performance Bond in an amount equal to one hundred percent (100%) of the Contract Sum, as security for the faithful performance of the Contract and also a one hundred percent (100%) Payment Bond, as security for the payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with the Contract. The Performance Bond and the Payment Bond

may be in one or in separate instruments in accordance with local law. Surety companies must be authorized to write surety bonds in Texas and any such surety bond must comply with the requirements of Subchapter A of 3503 of the Texas Insurance Code.

11.1.1.6.2 The Contractor shall deliver the bonds not later than the tenth (10^{th}) day after the date the Contractor executes this Agreement unless the Contractor furnishes a bid bond or other financial security acceptable to the Owner to ensure that the Contractor will furnish the required performance and payment bonds when a guaranteed maximum price is established. All Bonds will be reviewed by the Architect for compliance with the Contract Documents prior to the execution of the Contract. In the event that Architect has any questions concerning the sufficiency of the bonds, Architect shall refer the bonds to Owner or Owner's representative for decision. The Work will not be started until the bonds and issuing companies have been accepted as satisfactory by the Owner.

11.1.1.6.3 All bonds shall be originals. The Contractor shall require the attorney-in-fact who executes the required Bonds on behalf of the Surety to affix thereto a certified and current copy of the power-of-attorney. The name, address, and telephone number of a contact person for the Bonding Company shall be provided.

11.1.1.6.4 The Bonds shall be provided to comply with the terms and provisions of Chapter 2253 of the Texas Government Code. Bonds shall be signed by an agent resident in the State of Texas and date of bond shall be on or after the date of execution of the Contract but prior to the date of the notice to proceed. If at any time during the continuance of the Contract, the surety of the Contractor's bonds becomes insufficient, the Owner shall have the right to require additional and sufficient sureties which the Contractor shall furnish to the satisfaction of the Owner within ten (10) days after notice to do so. In default thereof, the Contractor may be suspended, and all payment or money due to the Contractor withheld until sufficient bonds are provided by Contractor.

11.1.1.6.5 Claims must be sent to the Contractor and his Surety, in accordance with Texas Government Code, Chapter 2253. The Owner will furnish in accordance with such Article, a copy of the payment bond, as provided therein, to claimants upon request. All claimants are cautioned that no lien exists on the funds unpaid to the Contractor on such Contract, and that reliance on notices sent to the Owner may result in loss of their rights against the Contractor and/or his Surety. The Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no responsibility because of any representation by any agent or employee.

11.2 <u>Owner's Liability Insurance</u>

Insert new paragraphs 11.2.1.1 through 11.2.1.4:

11.2.1.1 By signing the Contract or providing or causing to be provided a Certificate of Coverage, the Contractor is representing to the 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 coverage will be based on proper reporting or 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 commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

11.2.1.2 Optionally, the Owner may require the Contractor to purchase and maintain Project Management Protective Liability insurance from the Contractor's usual sources as primary coverage for the Owner's, Contractor's and Architect's vicarious liability for construction operations under the contract. Unless otherwise required by the Contract Documents, the Owner shall reimburse the Contractor by increasing the Contract Sum to pay the cost of purchasing and maintaining such optional insurance coverage and the Contractor shall not be responsible for purchasing any other liability insurance on behalf of the Owner. The minimum limits of liability purchased with such coverage shall be equal to the aggregate of the limits required for Contractor's Liability Insurance under Article 11.

11.2.1.3 The Owner shall obtain and furnish Builder's Risk insurance. The Contractor is responsible to pay $10,000 of each Builder's Risk claim deductible, or the actual value of the deductible amount, whichever is the lesser amount.

11.2.1.4 The Contractor shall be responsible for obtaining an Installation Floater Insurance Policy for any protections desired beyond the policy limits provided by the Owner's Builder's Risk Policy.

11.3 Waivers of Subrogation

Replace paragraph 11.3.1 and 11.3.2 with the following language and insert new paragraph 11.3.3 as follows:,

11.3.1 The Contractor waives all rights against (1) Owner, the Subcontractors, Sub-subcontractors, agents, and employees, and (2) the Architect, Architect's consultants, separate contractors, if any, and any of their Subcontractors, Sub-subcontractors, agents, and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to Article 11 or other property insurance applicable to the Work, except such rights as Contractor has to proceeds of such insurance held by the Contractor as a fiduciary. The Contractor, as appropriate, shall require of any separate contractors, Subcontractors, Sub-subcontractors, agents, and employees of any of them by appropriate written agreements, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

11.3.2 A loss insured under the Owner's property insurance shall be adjusted by the

Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.3. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

11.3.3 The Owner shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement.

ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK

12.1 Uncovering of Work

12.1.1 At the end of the paragraph delete "." and insert "or Contract Sum."

12.2 Correction of the Work

12.2.1 Before Substantial Completion

12.2.1 In line 1 after ""by the Architect" insert "as incomplete, defective,".

12.2.2.1 In line 2, after "of the" add "entire"; after "Work" delete "or designated portion thereof or after the date for commencement of warranties established under Subparagraph 9.9.1," and substitute "(unless otherwise provided in any Certificate of Partial Substantial Completion approved by the parties), or within such longer period of time as may be prescribed by law or in equity,". In line 6, after "condition." delete the next two grammatical sentences and substitute the following: "This corrective period shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between substantial Completion and the actual performance of the Work. Corrective Work shall be warranted to be free from defects for a period equal to the longer of six (6) months after the completion of the corrective Work or one (1) year after the Date of Substantial completion (subject to extension as previously described) or such longer period of time as may be prescribed by law or in equity, or expiration of the term of any applicable special warranty, if applicable, required by the Contract Documents. Any defect in such Work shall be corrected again by Contractor promptly upon notice of the defect from Owner. Upon receipt of written notice from the Owner of the discovery of any defects in the Work, the Contractor shall commence remedy of such defects and replace any property damaged therefrom occurring within the warranty and guarantee period within forty-eight (48) hours. Work forces to repair or replace damaged property shall be maintained on a consistent basis until resolution. The Owner remedy work directly if the damage or failure constitutes and emergency threatening the life, health, or safety or could create significant consequential damages. In the case of

emergency repairs, the Contractor shall compensate the Owner for reasonable costs incurred. If the Contractor, after notice, fails to proceed promptly and remedy within the period of time for remedial action within this paragraph or which has been otherwise agreed to in writing, in compliance with the terms of the warranty and guarantee, the Owner may have the defects corrected and the Contractor and/or its surety shall be liable for all actual expenses incurred by Owner, Architect or Project Manager. This obligation under this Subparagraph 12.2.2.1 shall survive acceptance of the Work under the Contract and termination of the Contract by the Owner."

Replace paragraph 12.2.2.2 with the following language and delete paragraph 12.2.2.3

12.2.2.2 Just before the termination of the various guarantee periods, Contractor shall accompany Owner and Architect on an inspection and tour of the building and Project site and shall note and call out any defects and shall start remedying these defects within ten (10) days of the inspection tour and shall prosecute the Work without interruption until accepted by Owner and Architect, even though such prosecution should extend beyond the limit of the guarantee period. If the Contractor, after notice, fails to proceed promptly and remedy within ten (10) days or within another period of time which has been agreed to in writing, in compliance with the terms of the warranty and guarantee, the Owner may have the defects corrected and the Contractor and/or its surety shall be liable for all actual expenses incurred by Owner, Architect or Project Manager.

12.2.4 In line 2, after "caused" add "in whole or in part". In line 3, after "that is" add "defective or otherwise".

12.2.5 In line 2, after "Documents" delete "." and insert "or under law or in equity." In line 2 delete "one year".

12.3 <u>Acceptance of Nonconforming Work</u>

12.3 In line 1, after "is" insert "defective or otherwise".

ARTICLE 13 – MISCELLANEOUS PROVISIONS

13.3 <u>Rights and Remedies</u>

13.3.1 At the end of the paragraph delete "." and insert "or in equity or by any other agreement, and any such rights and remedies shall survive the acceptance of the Work and/or any termination of the Contract Documents."

13.4 <u>Tests and Inspections</u>

13.4.1 Delete the last two grammatical sentences in their entirety and insert the following, "Architect, Owner and Contractor shall be afforded a reasonable opportunity to attend, observe, and witness all inspections and tests of the Work. Architect or Owner may at any time request and receive from Contractor satisfactory evidence that materials,

supplies, or equipment are in conformance with the Contract Documents. The conduct of any inspection or test and the receipt of any approval shall not operate to relieve Contractor from its obligations under the Contract Documents unless specifically so stated by Owner in writing."

13.4.2 Delete the last grammatical sentence in its entirety.

13.4.3 In line 2, after "Documents," delete the remainder of the subparagraph and substitute the following: "or reveal faulty or otherwise defective Work, or if the necessity of any such testing, inspection, or approval procedure arises out of the fault, neglect, or omission of Contractor, Contractor shall bear all costs of such testing, inspection, and approval procedures and all other costs made necessary by Contractor's failures, including, without limitation, those costs of repeated and additional procedures and compensation for Architect's services and expenses of Owner's personnel and consultant fees and expenses. Such costs shall be paid by Contractor within ten (10) days of receipt of invoice from Owner with supporting data attached."

13.4.4 In line 1 delete, "unless otherwise required by the Contract Documents,". In Line 2 delete, "promptly delivered to the Architect" and insert, "delivered to Owner, unless such testing or inspection services are arranged by Owner."

13.5 Interest

Delete paragraph in its entirety and replaced with the following, "An overdue payment bears interest at the rate of one half percent (.5%) each month, or at the legal rate established by the Texas Government Code, currently in Section 2251.025. Any such payment for any undisputed amounts shall be deemed overdue on the thirty-first (31st) day after Owner receives an acceptable invoice from Contractor."

Insert new Article 13.6 as follows:

13.6 Equal Opportunity

13.6.1 The Contractor shall maintain policies of employment as follows: "The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, promotion, demotion, or transfer; recruitment, or recruitment advertising; lay-off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants, notices setting forth the nondiscrimination policies."

13.6.1.1 The Contractor and the Contractor 's Subcontractors shall, in all solicitations or

advertisements for employees placed by them or on their behalf; state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, or national origin.

Insert new 13.7 as follows:

13.7 Certification of Asbestos-Free Project

13.7.1 Contractor shall submit to the Architect a letter addressed to the Owner certifying that all materials used in the construction of this Project contain less than 0.10 by weight of asbestos and for which it can be demonstrated that, under reasonably foreseeable job site conditions, will not release asbestos fibers in excess of 0.1 fibers per cubic centimeter. Certification letters shall be dated, shall reference this specific Project, and shall be signed by at least one officer of the construction company.

13.7.2 Certification shall further state that should asbestos fibers be found at this Project in concentrations greater than 0.1 fibers per cubic centimeter, that Contractor shall be responsible for determining which materials contain asbestos fibers and shall take corrective action to remove those materials from the Project at no additional cost to the Owner.

13.7.3 Final payment shall not be made until this letter of certification has been received.

ARTICLE 14 – TERMINATION OF SUSPENSION OF THE CONTRACT

14.1 Termination by the Contractor

14.1.1.3 After "documents" add "other than what is permitted in Section 9.6.1.

14.1.1.4 Delete paragraph in its entirety.

14.1.3 In line 2 after "Work" insert "properly". In line 3 after "executed" insert, "in accordance with the Contract Documents." In line 3 delete "as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination."

14.1.4 Delete paragraph in its entirety and insert the following in lieu thereof, "Owner shall not be responsible for damages for loss of anticipated profits on Work not performed on account of any termination described in Subparagraphs 14.1.1 and 14.1.2."

14.2 Termination by the Owner for Cause

14.2.1.1 Delete "repeatedly" and insert "and equipment" after "materials."

14.2.1.3 Delete "repeatedly" and delete "or" at the end of the paragraph.

14.2.1.4 Delete subparagraph in its entirety and replace with the following, “disregards the instructions of Architect or Owner (when such instructions are based on the requirements of the Contract Documents); or”

Insert new 14.2.1.5 and 14.2.1.6 as follows:

14.2.1.5 “is adjudged a bankrupt or insolvent, or makes a general assignment for the benefit of Contractor’s creditors, or a trustee or receiver is appointed for Contractor or for any of its property, or files a petition to take advantage of any debtor’s act, or to reorganize under bankruptcy or similar laws; or

14.2.1.6 “otherwise does not fully comply with the Contract Documents.”

14.2.2 In line 1, after “exist” delete “, and upon certification by the Initial Decision Maker that sufficient cause exists to justify such action”.

14.2.4 Delete paragraph in its entirety and replace with the following, “To the extent the costs of completing Work, including compensation for additional professional services and expenses, exceed those costs that would have been payable to Contractor to complete the Work except for Contractor’s default, Contractor will pay the difference to Owner, and this obligation for payment shall survive termination of the Contract. Such costs incurred by Owner will be determined by Owner and confirmed by Architect.”

Insert new paragraph 14.2.5, 14.2.6, and 14.2.7 as follows:

14.2.5 In addition to Owner’s right to remove Contractor from any part of Work pursuant to the Contract Documents, Owner may, at any time, at will and without cause, terminate any part of Work or any subcontract or all remaining Work for any reason whatsoever by giving seven (7) days’ prior written notice to Contractor specifying the part of Work or subcontract to be terminated and the effective date of termination. Contractor shall continue to prosecute the part of Work not terminated. If any part of Work or subcontract is so terminated, Contractor shall be entitled to payment for Work properly executed in accordance with the Contract Documents (the basis for such payment shall be as provided in the Contract) and for costs directly related to Work thereafter performed by Contractor in terminating such Work or subcontract including reasonable demobilization and cancellation charges provided said Work is authorized in advance by Architect and Owner. No payment shall be made by Owner; however, to the extent that such Work or subcontract is, was, or could have been terminated under the Contract Documents or an equitable adjustment is made or denied under another provision of the Contract. In case of such termination, Owner will issue a Construction Change Directive or authorize a Change Order making any required adjustment to the Date of Substantial Completion and/or the Contract Sum. For the remainder of the Work, the Contract Documents shall remain in full force and effect.

14.2.6 Owner shall not be responsible for damages for loss of anticipated profits on Work not performed on account of any termination described in Subparagraph 14.2.5.

14.2.7 Upon a determination by a court of competent jurisdiction that termination of Contractor pursuant to Subparagraph 14.2.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Subparagraph 14.2.5 and Contractor's remedy for wrongful termination shall be limited to the recovery of the payments permitted for termination for convenience as set forth in Subparagraph 14.2.5."

14.4.3 Delete section in its entirety and replace with "In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly completed to date, including the Contractor's overhead and profit on that portion of properly completed work. Under no circumstances shall the Contractor be compensated for loss of revenue or anticipated profits from portions of the work not completed."

ARTICLE 15 – CLAIMS AND DISPUTES

15.1.1 Definitions

In line 1 after "matter of right" insert "adjustment or interpretation of the Contract Terms." After the second sentence insert, "Claims must be by written notice."

15.1.2 Time Limits on Claims

In line 2 delete "in accordance with the requirements of the binding dispute resolution method selected in the Agreement". In line 4 delete "," after "applicable law" and insert "." In line 4 delete "but in any case more than 10 years after the date of Substantial Completion of the Work." Delete last grammatical sentence in its entirety.

15.1.3 Notice of Claims

15.1.3.1 In line 2 after "shall be initiated by" add "written". At the end of the paragraph insert the following, "Said written notice of claims shall state specifically the reason for the claim, the date or dates of the cause of causes of the claim, and if any extension of time is requested, the number of days of extension requested."

15.1.5 Claims for Additional Cost

After the first sentence insert the following, "Said notice shall itemize all claims and shall contain sufficient detail and substantiating data to permit evaluation of same by Owner and Architect. No such claim shall be value unless so made."

15.1.6 Claims for Additional Time

15.1.6.2 At the end of the paragraph and the sentence, "Such claims shall be given to the Owner within fourteen (14) days after the occurrence of the event justifying the claim.

Insert new “15.1.6.3, 15.1.6.3.1, 15.1.6.3.2, 15.1.6.3.3, 15.1.6.3.4, and 15.1.6.3.5 as follows**:**

15.1.6.3 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions at the Project and that they had an adverse effect on the critical path of the construction schedule. The Contract Time shall not be extended nor shall the Contract Sum be increased, due to any adverse weather conditions experienced unless (a) the total number of weather-caused days of delay exceeds the Anticipated Weather Days, and (b) the critical path is delayed as a direct result of such adverse weather.

15.1.6.3.1 Anticipated Weather Days: An allowance of Thirty (30) Regular Work Days, established as probable days lost due to weather delays; said allowance shall be included in the Contractor's proposed Completion Time in the Proposal.

15.1.6.3.2 Evaluation of Delay Days: The Owner will evaluate delays claimed by the Contractor based on the critical path of the Contractor's construction schedule, and if it is determined by the Owner that a critical path task has been delayed due to circumstances beyond the Contractor's control, the accepted delay days will be deducted from the Anticipated Weather Delay Day Allowance.

15.1.6.3.3 Weather Days: Regular Work Days when Work is planned to occur that day and when rain exceeds .50” in one calendar day that impacts the current critical path of construction The official weather measurement shall be taken from www.weatherunderground.com for the City where the Project is located. Unusually high winds, mud, or snow are not considered a weather day. The Contractor will be entitled to an extension of the Contract Time for the net additional time, if any, which results from deducting the amount of Anticipated Weather Days from the total amount of actual Weather Days

15.1.6.3.4 Net Weather Days: The difference in working days between the total amount of Anticipated Weather Days and total amount of Weather Days incurred.

15.1.6.3.5 Contractor shall not be entitled to claims for additional time and/or increase in Contract Price due to a problem or non-performance of a subcontractor.

15.2 Initial Decision

15.2.2 In line 3 after “Approve the Claim” insert “in whole or in part”.

15.2.5 In line 6 delete “binding dispute resolution” and insert “litigation”.

15.2.6 Delete in its entirety. Add Intentionally Deleted.

15.2.6.1 Delete in its entirety.

15.2.8 Delete in its entirety.

15.3 Mediation

Delete sections 15.3.1, 15.3.2, 15.3.3 and 15.3.4 in their entirety and replace with the following:

§ 15.3.1 If the parties to a dispute arising out of or related to the Contract agree to submit the Claim to mediation following a decision by the Initial Decision Maker, the parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof. Nothing in the Contract Documents shall be construed as requiring mandatory mediation prior to litigation.

15.4 Arbitration

Delete 15.4.1, 15.4.1.1, 15.4.2, and 15.4.3 in their entirety and insert the following in lieu thereof, "The parties expressly agree that disputes or claims arising under the Contract Documents shall not be subject to arbitration unless mutually agreed by the parties in writing."

15.4.4 Consolidation or Joinder

Delete 15.4.4.1, 15.4.4.2 and 15.4.4.3 in their entirety.

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Bid Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

BOND AMOUNT: $ « »

PROJECT:
(Name, location or address, and Project number, if any)

«
« »
« »

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

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

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Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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User Notes: (1145336434)

Signed and sealed this « » day of « » , « »

	« »
	(Contractor as Principal) *(Seal)*
	« »
(Witness)	*(Title)*
	« »
	(Surety) *(Seal)*
	« »
(Witness)	*(Title)*

DRAFT

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User Notes: (1145336434)

AIA® Document A312™ – 2010

Payment Bond

CONTRACTOR:
(Name, legal status and address)

SURETY:
(Name, legal status and principal place of business)

OWNER:
(Name, legal status and address)

CONSTRUCTION CONTRACT
Date:
Amount: $
Description:
(Name and location)
SAMPLE

BOND
Date:
(Not earlier than Construction Contract Date)

Amount: $
Modifications to this Bond: ☐ None ☐ See Section 18

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or **BROKER:**

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

ADDITIONS AND DELETIONS:
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Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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User Notes: (2021019439)

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

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§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

- .1 the name of the Claimant;
- .2 the name of the person for whom the labor was done, or materials or equipment furnished;
- .3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
- .4 a brief description of the labor, materials or equipment furnished;
- .5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- .6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
- .7 the total amount of previous payments received by the Claimant; and
- .8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

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§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:	_____	Signature:	_____
Name and Title:		Name and Title:	
Address:		Address:	

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(2021019439)

AIA® Document A312™ – 1984

Performance Bond

CONTRACTOR *(Name, Legal Status and Address)*:

SURETY *(Name, Legal Status and Principal Place of Business)*:

OWNER *(Name, Legal Status and Address)*:

CONSTRUCTION CONTRACT
Date:
Amount: $
Description *(Name and Location)*:
SAMPLE

BOND
Date *(Not earlier than Construction Contract Date)*:
Amount: $
Modifications to this Bond: ☐ None ☐ See Section 13

CONTRACTOR AS PRINCIPAL		**SURETY**	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	

(Any additional signatures appear on the last page)

(FOR INFORMATION ONLY - Name, Address and Telephone)

AGENT or **BROKER**:

OWNER'S REPRESENTATIVE *(Architect, Engineer or other party)*:

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

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

Any singular reference to Contract, Surety, Owner or other party shall be considered plural where applicable.

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User Notes: (1699502695)

§ 1 The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Section 3.1.

§ 3 If there is no Owner Default, the Surety's obligation under this Bond shall arise after:
§ 3.1 The Owner has notified the Contractor and the Surety at its address described in Section 10 below that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and

§ 3.2 The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Section 3.1; and

§ 3.3 The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.

§ 4 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
§ 4.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or

§ 4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; or

§ 4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or

§ 4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or

.2 Deny liability in whole or in part and notify the Owner citing reasons therefor.

§ 5 If the Surety does not proceed as provided in Section 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 4.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 6 After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Section 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:

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User Notes: (1699502695)

§ 6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

§ 6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 4; and

§ 6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 7 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators or successors.

§ 8 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 9 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 10 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

§ 11 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 12 DEFINITIONS

§ 12.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 12.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

§ 12.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

§ 12.4 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

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§ 13 MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:		Name and Title:	
Address:		Address:	

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SECTION 000820 - SCHEDULE OF VALUES

1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, apply to this Section.

B. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. The Schedule of Values shall follow the sections of the specifications and shall be subdivided into detailed categories as follows:

1. Costs for such items as Performance and Payment Bonds, Contractor's insurance, permits and plan checking fees, mobilization, office coordination, job site supervision, field engineering, miscellaneous general conditions, contract close out, trench safety and fee shall be listed as individual line items.

2. Costs for various construction items such as sitework and concrete shall be subdivided and detailed. For example, concrete work shall be subdivided into such items as drilling footings, footing reinforcing in place, footing concrete in place, grade beam materials, grade beam labor, etc. These subdivisions shall appear as individual line items.

3. All subcontracts shall be subdivided in detail. For small subcontracts, the subdivision of costs may be limited to individual line items for labor and materials; for larger and more complex subcontracts, the subdivision of costs shall include costs of various components and equipment and labor for each,

4. The cost of the individual items of subcontract work shall total the amount of the specific subcontract. There shall be no addition of contractor's overhead or other costs such as general conditions, supervision and fee.

5. Where payment for suitably stored materials may be requested prior to installation, material and labor costs shall be listed as individual line items and subdivided in detail.

6. Where work occurs at more than one building, for the Owner's accounting purposes and to facilitate the checking of the Contractor's Application for Payment, costs shall be scheduled separately for each campus.

1.3 SUBMITTALS

A. The Schedule of Values shall be submitted in triplicate to the Architect for review as soon as possible after the award of contract and at least seven days prior to the submission of the first application for payment.

B. The Schedule of Values shall be submitted on the Continuation Sheet, AIA Document G703-1992.

C. Contractor's wishing to use computerized versions of AIA Document G703-1992 shall submit an example in advance to the Architect for approval. Generally, such versions shall match the format of AIA Document G703-1992.

D. Acceptability of detail provided on the Schedule of Values will be determined solely by the Architect.

END OF SECTION

APPLICATION AND CERTIFICATION FOR PAYMENT

AIA DOCUMENT G702

TO OWNER:

PROJECT:

APPLICATION NO:

Distribution to:

- ☐ OWNER
- ☐ ARCHITECT
- ☐ CONTRACTOR
- ☐
- ☐

PERIOD TO:

FROM CONTRACTOR:

VIA ARCHITECT:

PROJECT NOS:

CONTRACT FOR:

CONTRACT DATE:

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM		$
2. Net change by Change Orders		$
3. CONTRACT SUM TO DATE (Line 1 ± 2)		$
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)		$
5. RETAINAGE:		
a. _____ % of Completed Work (Column D + E on G703)	$	
b. _____ % of Stored Material (Column F on G703)	$	
Total Retainage (Lines 5a + 5b or Total in Column I of G703)		$ 0.00
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total)		$ 0.00
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)		$
8. CURRENT PAYMENT DUE		$ 0.00
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)	$	0.00

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner		
Total approved this Month		
TOTALS	$0.00	$0.00
NET CHANGES by Change Order	$0.00	

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for 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.

CONTRACTOR:

By: _____ Date: _____

State of: County of:
Subscribed and sworn to before me this day of
Notary Public:
My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising the application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED . . . . . $ _____

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and onthe Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

AIA DOCUMENT G702 · APPLICATION AND CERTIFICATION FOR PAYMENT · 1992 EDITION · AIA® · © 1992 THE AMERICAN INSTITUTE OF ARCHITECTS, 1735 NEW YORK AVE., N.W., WASHINGTON, DC 20006-5292

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CONTINUATION SHEET

AIA DOCUMENT G703

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing
Contractor's signed certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
			FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					
	GRAND TOTALS	$0.00	$0.00	$0.00	$0.00	$0.00	0.00%	$0.00	

Users may obtain validation of this document by requesting of the license a completed AIA Document D401 - Certification of Document's Authenticity

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

DISTRICT:

Facility:

ARCHITECT/ENGINEER:

Address:

CONTRACTOR/CM:

City:

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 educational 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.

SECTION 011000 – SUMMARY OF WORK

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: IDEA San Benito Mechanical and Controls Upgrades

1. Project Location: See Drawings.

2. Owner: IDEA Public Schools

B. Engineer: Ethos Engineering, 1126 South Commerce, Harlingen, Texas 78550.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

B. Specification division numbers are not intended to dictate WHO will be doing the work. The following scope of mechanical work includes work specified in drawings and specifications. All the work must be done and coordinated, regardless of whether it is done under the Sub Contractor or by the General Contractor.

C. Scope of Work: Provide all materials and labor associated with complete operational systems. Major items of work include, but are not limited to:
   1. Replacement of HVAC equipment, including but not limited to the following:
      a. DX central station air-handling units (AHUs) to match existing DX air-cooled condensing units (ACCUs) that will be retained and reused.
      b. DX ACCUs to match existing AHUs that will be retained and reused.
   2. Modification of ductwork, refrigerant piping, insulation, controls, and electrical systems.
   3. Replacement of Building Automation System Controls.
      a. Base Proposal with ALC
      b. Alternate Proposal with JCI.
   4. Testing, adjusting, and balancing.
   5. Cutting and patching and touchup painting as required.
   6. Concrete work as needed.
   7. Assistance with commissioning services per specifications.
   8. Allowances: The owner has set aside allowances for unforeseen circumstances. See Section 012100.

D. Type of Contract:
   1. Project will be constructed under a single prime contract.

1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in one phase.

B. Before commencing Work, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates for all phases of the Work.

1.6 WORK BY OWNER

A. Not Applicable.

1.7 WORK UNDER SEPARATE CONTRACTS

A. Not Applicable.

1.8 FUTURE WORK

A. Building Automation System may be updated and upgraded, or replaced with new under a future project.

1.9 PURCHASE CONTRACTS

A. Not Applicable.

1.10 OWNER-FURNISHED PRODUCTS

A. Not Applicable.

1.11 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS

A. Not Applicable.

1.12 ACCESS TO SITE

A. General: Contractor 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. Coordinate details with Owner and Architect.

B. Use of the Site: Limit use of the premises to work in areas indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
   1. Owner Occupancy: Allow for Owner occupancy and use by the public.
   2. Limits: Confine operations to areas within contract limits indicated.
   3. Driveways, Walkways and Entrances: Keep driveways parking garage, 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.

C. 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.

D. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
   1. Temporary fencing around construction areas, and around equipment while site work is in progress.
   2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
   3. Work shall take place with minimal disruption to Owner's operations in areas surrounding the job site.

1.13 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and existing 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. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
2. 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 authorities having jurisdiction.

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: Schedule activities in close coordination with Owner. When school is in session, limit work in the existing building to breaks, afterhours and weekends, unless otherwise indicated.

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 Owner not less than two days in advance of proposed utility interruptions.
2. Obtain 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 Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

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 is not permitted.

G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
1. Maintain list of approved screened personnel with Owner's representative.

1.15 WORK SEQUENCE AND DEADLINES

A. **The Bid requires that the project be certified Finally Complete within the time limits imposed in the Bid Form.** Failure to comply with contract completion dates will result in assessment of liquidated damages.

B. **Extended power or air conditioning outages, and disruptive indoor work must take place only during unoccupied hours or on weekends.** All electrical, HVAC systems shall be operational by the next occupancy period.

1.16 COORDINATION

A. All questions, requests for information, submittals, and correspondence from the Contractor shall be submitted via the General Contractor, who will forward to the Engineer.

B. Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Engineer, General Contractor, Suppliers, Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.

C. Contractor shall issue seven (7) days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered (below grade).

D. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required:
   1. Electrical:
      a. Upon completion of pulling all wiring, making all terminations, labeling and color-coding wires at the panel-boards and prior to installing their covers.
   2. When ready for Systems Readiness Checklists (Commissioning).
   3. When ready for Functional Performance testing (Commissioning).
   4. When ready for Substantial Completion Inspection.
   5. When ready for Final Inspection.
   6. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is this contractor’s responsibility to make sure Engineer receives notification.

E. Construction Coordination:

   1. The contractor shall supply a complete and comprehensive construction schedule for the project. This schedule shall include durations for the specific tasks required, and shall demonstrate a construction process chain of events, organized to create minimum disruption and minimum inconvenience to building occupants.
   2. Contractor shall organize daily work schedules to accommodate the building occupants' functions, comfort, and work schedules. Mandatory achievement of a non-disruptive environment shall be the sole responsibility of the Contractor, and shall at no time incur additional charges for Owner. This shall include weekend and evening work hours, if necessary, to accomplish non-disruptive requirement, and on-schedule completion.
   3. A non-disruptive environment shall be defined as: an environment where large-scale activities, or activities causing extreme noise and/or inconvenience are minimal in occupied areas during occupied times. When disruptive tasks must occur during occupied hours, such activities shall be coordinated with Owner’s personnel a minimum of one week in advance.

F. Waste Material and Debris: All waste material and debris from this project shall become the property of the contractor and shall be removed from the site. Exterior of the site shall be kept clean and free of material and debris from this project at all times. All waste material and debris generated by any work under this contract shall be handled, transported, stored, and disposed by the contractor and by his subcontractors in accordance with all applicable Federal, State, and local laws, ordinances, regulations, court orders, or other types of rules or rulings having the effect of law including, but not limited to, Executive Order 11752, 17 December 1978; the

Federal Water pollution Control Act, as amended, 33 USC, Sec. 1251 et seq; the Clean Air Act, as amended, 42 USC, Sec. 7401 et seq; the Solid Waste Disposal Act, as amended, 41 USC sec 136 et seq; the Endangered Species Act of 1973, as amended, 16 USC, Sec 153 et seq; and the Environmental Protection Agency guidelines on thermal processing and land disposal of solid waste (40 CFR 240 and 241).

1.17 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.

1.18 SUBMITTALS

A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information, which is not applicable to the equipment being supplied for this project.

B. Faxes and copies of faxes are not acceptable.

C. Provide sufficient copies of approved data, with the engineer's approved stamp, for inclusion in the operations and maintenance manuals.

D. Electrical Submittals shall be submitted in no more than one three ring binder.

E. Partial submittals shall not be reviewed until a complete bound submittal package is received.

F. Allow two weeks for initial submittal review by Engineer, from the day it is received at the Engineer's office.

G. Allow one week for review of resubmittals by Engineer.

H. All submittal review comments shall be forwarded by Engineer to Engineer, who will then distribute as per Division 1.

1.19 SCHEDULE OF VALUES

A. Schedule of Values shall be included with bound submittals. Submittals without a Schedule of Values **shall not** be reviewed.

B. Contractor shall submit a Schedule of Values reflecting the total value of Work in the Contract and broken down into the following items as a minimum, with a line item for Materials/Equipment and another for Labor.
   1. Structural
   2. HVAC
   3. Electrical
   4. Controls
   5. TAB
   6. Commissioning
   7. Water Treatment
   8. Allowances
   9. Miscellaneous.
   10. Administrative and project management.

1.20 MISCELLANEOUS PROVISIONS

A. Code Compliance:
   1. Occupational Safety and Health Act (OSHA)
   2. National Electric Code (NEC)
   3. National Fire Code
   4. International Building Code
   5. UL 916
   6. Local ordinances

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

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 governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Engineer from the designated supplier.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

SECTION 012100 - ALLOWANCES

1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work.

1.7 ALLOWANCES

A. Use the allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contract Sum shall include Contractor's overhead and profit, insurance and bonding for the Contingency and other specific Allowances.

C. Change Orders or Allowance Expenditures authorizing use of funds from the Contingency or other specific Allowances will not include Contractor's overhead and profit, nor insurance and bonding. Other related costs such as equipment rental, delivery charges, etc. can be included in these costs, but all costs must be submitted by the general contractor with itemized (or unit) pricing from the subcontractor(s) and/or material supplier(s).

D. At Project closeout, credit unused amounts remaining in allowances to Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Include listed Owner's Contingency Allowance for additional work and unforeseen circumstances. Allowance will be used only as directed by Owner and Engineer with a written consent.
   1. Allowance No. 1 –San Benito: **$75,000**.

END OF SECTION 012100

SECTION 012900 - PAYMENT PROCEDURES

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 necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Engineer at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.

b. Name of Engineer.
c. Engineer's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification Section or Division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

1) Labor.
2) Materials.
3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts, where appropriate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment shall be as per mutual agreement between Owner and Contractor. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days before the date for each progress payment.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule (preliminary if not final).
7. Copies of building permits.
8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
9. Certificates of insurance and insurance policies.
10. Performance and payment bonds.
11. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.

4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

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 provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in 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 ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if 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 to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of Engineerural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show Engineerural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: **Schedule and conduct** a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than **15** days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Lines of communications.
f. Procedures for processing field decisions and Change Orders.
g. Procedures for RFIs.
h. Procedures for testing and inspecting.
i. Procedures for processing Applications for Payment.
j. Distribution of the Contract Documents.
k. Submittal procedures.
l. Preparation of record documents.
m. Use of the premises and existing building.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
2. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
3. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 30 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.

b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.
l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

3. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Progress cleaning.
11) Quality and work standards.
12) Status of correction of deficient items.
13) Field observations.
14) Status of RFIs.
15) Status of proposal requests.
16) Pending changes.

17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 8 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Include the following information for processing and recording action taken:

a. Project name.
b. Date.
c. Name of Engineer.
d. Name of Contractor.
e. Name of subcontractor.
f. Name of supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.
m. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

3. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Contractor.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner**,** containing the following information:

a. Project name.
b. Date.
c. Name and address of Engineer.
d. Name of Construction Manager.
e. Name of Contractor.
f. Name of firm or entity that prepared submittal.
g. Names of subcontractor, manufacturer, and supplier.
h. Category and type of submittal.
i. Submittal purpose and description.
j. Specification Section number and title.
k. Specification paragraph number or drawing designation and generic name for each of multiple items.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

F. Options: Identify options requiring selection by Engineer.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

2. Submittals: Submit 3 paper copies of each submittal unless otherwise indicated. Engineer will return 2 copies.
3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. PDF electronic file.
    b. Or 3 paper copies of Product Data unless otherwise indicated. Engineer will return 2 copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.
2. Submit Shop Drawings in the following format:

    a. PDF electronic file.
    b. Or 3 opaque (bond) copies of each submittal.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents may be returned by the Engineer without action.

END OF SECTION 013300

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

J. "Installer": An installer is the Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

K. The term "experienced," when used with an entity, means having successfully completed a minimum of **five** previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 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 date of the Contract Documents unless otherwise indicated.

C. Conflicting Requirements: If 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 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 requirements. Refer uncertainties to Engineer for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project should 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, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following

list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 016000 - PRODUCT 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 administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product 7 days prior to bidding. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered unless otherwise indicated.

4. Manufacturers:

    a. Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

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 administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

6. Engineer's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection. When cutting and patching structural elements, retain a licensed Structural Engineer. Notify Structural Engineer of locations and details of cutting and obtain written approval before proceeding. Shore, brace, and support structural elements during cutting and patching.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

a. Primary operational systems and equipment.
b. Fire separation assemblies.
c. Air or smoke barriers.
d. Fire-suppression systems.
e. Mechanical systems piping and ducts.
f. Control systems.
g. Communication systems.
h. Fire-detection and -alarm systems.
i. Conveying systems.
j. Electrical wiring systems.
k. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner

that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Cutting and Patching Conference: Before proceeding, meet at 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.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical, plumbing, and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

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

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

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

J. 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.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017320 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
   a. Roofing.
   b. Firestopping.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
      d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
      e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
      f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
      g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
   5. Comply with requirements for temporary enclosures, dust control, heating, and cooling.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."

D. Removed and Salvaged Items:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 017320

SECTION 017400 - GUARANTEES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, apply to this Section.

B. Refer to Instructions to Bidders for substitution of materials and products.

C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

A. Unless stated otherwise on the Certificate of Substantial Completion, all guarantees shall commence with the date of Substantial Completion.

B. Unless otherwise stated in these specifications, all guarantees shall include labor, material and delivery costs required for correction.

C. General: In addition to the General Contractor's one year guarantee for the entire project, guarantees shall be furnished by subcontractors and suppliers. These guarantees shall be submitted to the Engineer in duplicate prior to application for final payment. Refer to individual specification sections for additional guarantees and requirements.
   1. One Year Guarantees
      a. MEP SYSTEMs.
   2. Two Year Guarantees
      a. Controls
   3. Three Year Guarantees
      a. NA
   4. Five Year Guarantees
      a. DX Air-Cooled Condensing Units
   5. Ten Years Guaranty
      a. NA

PART 2 - PRODUCTS

2.1 GUARANTEES

A. Where guarantees are indicated to be provided by subcontractor or supplier, a detailed warranty written on the required form shall be provided. Refer to Section 017700 for Warranty forms.

B. Manufacturer's standard warranties shall be adjusted as required to include all specified requirements in addition to manufacturer's normal provisions. Manufacturer guarantees shall be written on appropriate printed letterhead.

2.2 MATERIALS

A. Unless otherwise approved by the Engineer, all replacement materials shall be new and provided by the same manufacturer as the original installation.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall arrange for all required inspections during the warranty period. Regardless of the wording of individual warranties, the Owner shall not be responsible for notification requirements for routine inspections during the General Contractor's warranty period.

B. Upon receipt of written or verbal notice by the Owner or Engineer of a deficiency, the Contractor shall promptly respond with inspection and repair during the General Contractor's warranty period.

C. The General Contractor shall be responsible for coordinating the activities of subcontractors, suppliers and manufacturers during the General Contractor's warranty period and the subcontractor/supplier/manufacturer extended warranty period.

END OF SECTION 017400

SECTION 017700 - CLOSEOUT PROCEDURES

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 contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.
   6. Final As-Built survey.

B. Related Requirements:
   1. "Construction Contract Close Out Checklist", of this Section.
   2. Additional requirements from Owner.
   3. Section 017300 "Execution" for progress cleaning of Project site.
   4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   6. Section 017900 "Demonstration and Training" for requirements for instructing Owner’s personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor’s List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 15 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number where applicable.
    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.
5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
7. Attic stock or extra materials for the Owner are not to be used for punchlist or warranty work, unless permission is given. In such case, the material is to be restocked and provided to the Owner.
8. Final Topographical and Property Survey: Submit one paper and electronic copy of the site, including all new and existing structures, sealed by a licensed surveyor, including a digital copy in AutoCAD.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 15 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection:

1. It is expected that Contractor will have thoroughly verified that all requirements have been fulfilled, and deficiencies repaired, before notifying Engineer that system is ready for final inspection, and before arranging final acceptance testing with Owner. Owner and Engineer therefore expect to make but one final inspection of system.
2. Submit a written request for final inspection for acceptance. Provide at least 7 days' notice to Owner and Owner's representative before test. Arrange mutually convenient time for conducting test.

3. On receipt of request, Engineer will either proceed with inspection. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
4. Reinspection:
    a. Should more than one “final” inspection be required due to significant deficiencies, Contractor will be required to reimburse Engineer at a rate of $200.00 per hour for expenses to cover any and all re-inspections required.
    b. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Page number.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner’s rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
5. Upload warranties and bonds to the Owner's cloud based document system.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.10 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

B. Electronic File of Project Record Documents: Provide Engineer with an independent electronic archive of accepted project record documents using electronic project management software as defined in Division 01 Section "Project Management and Coordination."

C. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings. Maintain a set of Contract Drawings and Shop Drawings for electronic project management software as defined in Division 01 Section "Project Management and Coordination".

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Mark important additional information that was either shown schematically or omitted from original Drawings.
4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets, and once approved, upload to the Owner's cloud based document system.

D. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

E. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

F. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Upload to the Owner's cloud based document system miscellaneous records and identify each, ready for continued use and reference.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation Data:
a. Emergency instructions and procedures.
b. System, subsystem, and equipment descriptions, including operating standards.
c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
d. Description of controls and sequence of operations.
e. Piping diagrams.
2. Maintenance Data:
a. Manufacturer's information, including list of spare parts.
b. Name, address, and telephone number of Installer or supplier.
c. Maintenance procedures.
d. Maintenance and service schedules for preventive and routine maintenance.
e. Maintenance record forms.
f. Sources of spare parts and maintenance materials.
g. Copies of maintenance service agreements.
h. Copies of warranties and bonds.

B. Organize operation and maintenance files into suitable sets of manageable size. Upload documents to the Owner's cloud based document system. Identify each file and cover document with the title

specific to the discipline noting “OPERATION AND MAINTENANCE MANUAL,” Project name, and subject matter of contents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal’s GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations at the maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 REQUIRED DOCUMENTS TO BE UPLOADED TO OWNER’S CLOUD BASED DOCUMENT SYSTEM

- As-Built Drawings
- Close-Out Files

Additional Required Electronic Documents:

- Punch Lists
- Special Tests
- Special Inspector Sign-Off
- Asbestos Affidavit
- Certificate of Occupancy
- Certificate(s) of Substantial Completion
- Owner Training / System Demonstrations (Sign-In sheet w/ hours)
- Change Orders
- As-Built Drawings
- Spare Parts / Attic Stock (Transmittal of delivery to Campus & IDEA sign-off)
- Subcontractor / Supplier Contact List
- Warranties
- Elevation Certificates
- Final Release of Liens
- Consent of Surety

3.2 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner’s personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner, through Engineer with at least seven days' advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.3 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

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

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain; clean according to manufacturer's recommendations if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

k. Replace chipped or broken glass and other damaged transparent materials.

l. Remove labels that are not permanent.

m. Touch up and otherwise repair and restore marred, exposed finishes and surfaces.

n. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

o. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

p. Wipe surfaces of mechanical, electrical, elevator, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

q. Replace parts subject to unusual operating conditions.

r. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

s. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

t. Clean ducts, blowers, and coils if units were operated without filters during construction.

u. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

v. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

w. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

D. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

E. Construction Waste Disposal: Comply with waste disposal requirements.

3.4 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    a. Do not paint over “UL” and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

3.5 ATTIC STOCK ITEMS

A. Provide the following items to Owner at the end of the project as Attic Stock. Prior to delivery of items, coordinate location with Owner for storage of items. Maintain log or transmittal letters identifying provided items and record of person receiving them on behalf of the Owner.

B. Only the Sections listed below that are applicable to the project scope of work shall have items provided. Sections not included in the project scope are not required to furnish attic stock.

SECTION 09900 – PAINTING

Paint:	(3) 5-gallon – Field Color
	(2) 5-gallon – Each Accent Color

SECTION 211313 – WET-PIPE SPRINKLER SYSTEMS

Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

SECTION 224713 – DRINKING FOUNTAINS

Filter Cartridges: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 3 of each.

SECTION 233300 – AIR DUCT ACCESSORIES

Fusible Links: Furnish quantity equal to 10 percent of amount installed.

SECTION 233423 – POWER HVAC VENTILATORS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Belts:	One set for each belt-driven unit.

SECTION 237413 – PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fan Belts:	One set for each belt-drive fan (if applicable)
Filters:	One set of filters for each unit.

SECTION 237433 – DEDICATED OUTDOOR-AIR UNITS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fan Belts:	One set for each belt-driven fan.
Filters:	One set for each unit.

SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Filters:	One set for each air-handling unit.
Fan Belts:	One set for each air-handling unit fan.

SECTION 230900 – INSTRUMENTATION AND CONTROLS

Adjustable Limited Range Wall Temperature Sensors (Thermostats): Provide extra thermostats: 5 of each type.

SECTION 260943.23 – RELAY-BASED LIGHTING CONTROLS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Lighting Control Relays: Provide five (5).

SECTION 262413 – SWITCHBOARDS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Potential Transformer Fuses: One of each type.

Control-Power Fuses: Three of each type.

Fuses and Fusible Devices for Fused Circuit Breakers: Three of each type.

Fuses for Fused Switches: Three of each size and type.

Fuses for Fused Power-Circuit Devices: One of each type.

Indicating Lights: One of each type.

SECTION 262416 – PANELBOARDS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Keys: Provide five (5).

Circuit Breakers Including GFCI and GFEP Types: Two of each type.

Fuses for Fused Switches: Three of each type.

SECTION 262726 – WIRING DEVICES

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Service/Power Poles: One of each type.

Floor Service-Outlet Assemblies: One of each type.

Poke-Through, Fire-Rated Closure Plugs: One of each type.

SECTION 262813 – FUSES

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fuses: Three of each type.

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fuses: Three of each type.

Fuse Pullers: Two for each size and type.

SECTION 262913 – ENCLOSED CONTROLLERS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fuses for Fused Switches: Three of each type.

Control Power Fuses: Three of each type.

Indicating Lights: Two of each type and color installed.

Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

SECTION 265116 – INTERIOR LIGHTING

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Light Fixtures: Lamps: Three of each type.

Diffusers and Lenses: Five of each type.

LED-luminaire-mounted emergency battery pack: Five of each type.

Globes and Guards: Three of each type.

SECTION 265219 – EMERGENCY AND EXIT LIGHTING

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Light Fixtures: Two of each type.

LED-luminaire-mounted emergency battery pack: Five of each type.

Diffusers and Lenses: Two of each type.

Globes and Guards: Two of each type.

SECTION 265621 – EXTERIOR LIGHTING

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Light fixtures: One of each type, no poles required.

Diffusers and Lenses: Two of each type.

Globes and Guards: Two of each type.

SECTION 267210 – FIRE ALARM SYSTEM

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fire Alarm Initiating Devices: Three of each type.

Fire Alarm Indicating Devices: Three of each type.

SECTION 267230 – SCHOOL INTERCOM AND PROGRAM EQUIPMENT

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Speakers Devices: Three of each type.

Call-in switch devices: Three of each type.

SECTION 267240 – INTRUSION DETECTION

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Intrusion Detection Devices: Three of each type.

PART 4 - PROJECT CLOSEOUT MANUAL AND FORMS

4.1 FORMS

A. The following forms shall be submitted to the Engineer during the construction contract close out process:

1. Contractor's Affidavit of Payment of Debts and Claims
2. Contractor's Affidavit of Payment of Release of Liens
3. Consent of Surety to Final Payment
4. General Contractor Affidavit and Release
5. Subcontractor/Supplier Affidavit and Release
6. General Contractor Guarantee
7. Subcontractor Guarantee
8. General Contractor Hazardous Material Certificate
9. Subcontractor/Supplier Hazardous Material Certificate

B. Use only the listed or enclosed forms.

4.2 PROJECT CLOSE OUT MANUAL

A. The Contractor shall assemble and deliver to the Engineer two (2) complete copies of the Project Close Out Manual consisting of the documents listed below and others as may be required under other sections of the Project Manual. Manual shall be constructed of a good quality vinyl 3 ring binder with all pages 8½" x 11".

B. First sheet shall identify the project, Owner, Engineer, Engineer's project number, Consultants and Contractor. Provide company name, address, telephone number and contact representative for each.

C. Subsequent pages shall include the Table of Contents as included herein and all project data included in the Table of Contents. Provide identifying tabs between all sections.

4.3 CLOSEOUT CHECKLIST

A. The Construction Contract Closeout Checklist included herein recaps the major items to be addressed during the close out process. This list is to be used by the Engineer and Contractor.

B. **Standard AIA forms are not included in this section, but shall be attached in the order given below.**

C. CONSTRUCTION CONTRACT CLOSEOUT MANUAL TABLE OF CONTENTS

1. Section 1: Contractor's Affidavit of Payment of Debts and Claims (AIA G706)
2. Section 2: Contractor's Affidavit of Release of Liens (AIA G706A)
3. Section 3: Consent of Surety to Final Payment (AIA G707)
4. Section 4: Certificate of Substantial Completion (AIA G704)
5. Section 5: General Contractor Affidavit and Release
6. Section 6: Subcontractor/Supplier Affidavit and Release (from each subcontractor and supplier)
7. Section 7: General Contractor Guarantee
8. Section 8: Subcontractor Guarantee (from each subcontractor)
9. Section 9: List of Final Subcontractors/Suppliers (AIA G805)
10. Section 10: Manufacturer's Guarantees and extended service contracts (NA)
11. Section 11: General Contractor Hazardous Material Certificate
12. Section 12: Subcontractor/Supplier Hazardous Material Certificate
13. Section 13: Miscellaneous
14. Section 14: N/A
15. Section 15: Mechanical Systems
16. Section 16: Electrical Systems
17. Section 17: Ceiling Systems
18. Section 18: Control System

GENERAL CONTRACTOR AFFIDAVIT AND RELEASE

STATE OF TEXAS PROJECT: _____

_____

OWNER: _____

COUNTY OF _____ ENGINEER: _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the contractor who constructed the project referenced above, and that, he/she is duly authorized to make this General Contractor Affidavit and Release.
2. That to the best of his/her knowledge and belief, all work required under the contract of the subject construction project has been performed in accordance with the terms thereof, there are no unsatisfied claims for damages resulting from injury or death to any employees, subcontractors, or the public at large arising out of the performance of said contract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.
3. That upon full payment of all sums due him/her for materials furnished and services rendered by the undersigned in connection with the performance of said contract, as evidenced by the amount shown on the Final Application and Certificate for Payment, the Contractor will release the Owner, the Engineer and the Engineer's consultants from any and all claims of any character arising out of or in any way connected with performance of said contract.

ATTEST (If Corporation)

_____

_____ _____

Secretary Name of Contractor

By _____ Date _____

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

SUBCONTRACTOR / SUPPLIER AFFIDAVIT AND RELEASE

STATE OF TEXAS PROJECT: _____

_____

OWNER: _____

COUNTY OF _____ ENGINEER: _____

KNOW ALL MEN BY THESE PRESENTS:

CONTRACTOR: _____

_____, being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the subcontractor/supplier who supplied, installed, and/or erected the work described below, and that, he/she is duly authorized to make this Subcontractor/Supplier Affidavit and Release:

   Work Performed:

   _____

   Specification Section(s): _____

2. That all work required under the subject subcontract or purchase order of the subject construction project has been performed in accordance with the terms thereof.
3. That to the best of his/her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said contract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.
4. That upon full payment by the Contractor of all sums due it for materials furnished and services rendered by the undersigned in connection with the performance of said contract, as evidenced by the final payment amount shown below, the Subcontractor/Supplier will release the Owner, the Engineer and the Engineer's consultants from any and all claims of any character arising out of or in any way connected with performance of said contract.

   a. Total Amount Paid to Date to this Subcontractor/Supplier: _____

   b. Final Payment Amount owed to this Subcontractor/Supplier: _____

   c. Final Subcontract Amount: _____

   (a + b = c)

ATTEST (If Corporation)

_____

_____ _____

Secretary Name of Subcontractor / Supplier

By _____ Date _____

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

GENERAL CONTRACTOR GUARANTEE

STATE OF TEXAS PROJECT: _____

_____

OWNER: _____

COUNTY OF _____ ENGINEER: _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the contractor who constructed the project referenced above, and that, he/she is duly authorized to make this General Contractor Guarantee.
2. The undersigned Contractor warrants to the Owner and Engineer that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's warranty excludes remedy from damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Owner or Engineer.
4. The Contractor warrants the entire project for a period of **12** months from the Date of Substantial Completion and specific sections of work for such additional periods as enumerated in the Contract Documents, except as follows:

ATTEST (If Corporation)

_____

_____ _____

Secretary Name of Contractor

By _____ Date _____

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

SUBCONTRACTOR GUARANTEE

STATE OF TEXAS

PROJECT: _____

_____

OWNER: _____

COUNTY OF _____

ENGINEER: _____

KNOW ALL MEN BY THESE PRESENTS:

CONTRACTOR: _____

_____, being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the subcontractor who supplied, installed, and/or erected the work described below, and that, he/she is duly authorized to make this Subcontractor Guarantee:

   Work Performed:

   _____

   Specification Section(s): _____

2. The undersigned Subcontractor warrants to the Owner and Engineer that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy from damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Engineer.
4. The Subcontractor warrants the work performed for a period of _____ months from the Date of Substantial Completion, except as follows:

ATTEST (If Corporation)

_____

_____ _____

Secretary Name of Subcontractor / Supplier

By _____ Date _____

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

GENERAL CONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

STATE OF TEXAS PROJECT: _____

_____

OWNER: _____

COUNTY OF _____ ENGINEER: _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the contractor who constructed the project referenced above, and that, he/she is duly authorized to make this Certification.
2. That to the best of his/her information, knowledge, and belief none of the below listed hazardous materials have been incorporated into the project:

- Asbestos
- Lead
- P.C.B. (Polychloride Biphenyls)
- Refrigerant R-11, R-12, R-113, R-114, R-500 and R-502

ATTEST (If Corporation)

_____

_____ _____

Secretary Name of Contractor

By _____ Date _____

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

STATE OF TEXAS

PROJECT: _____

_____

OWNER: _____

COUNTY OF _____

ENGINEER: _____

KNOW ALL MEN BY THESE PRESENTS:

CONTRACTOR: _____

_____, being first duly sworn, disposes and says:

1. That he/she is the _____ of _____, the subcontractor who supplied, installed, and/or erected the work described above, and that, he/she is duly authorized to make this Certification.
2. That to the best of his/her information, knowledge, and belief none of the below listed hazardous materials have been incorporated into the project:

- Asbestos
- Lead
- P.C.B. (Polychloride Biphenyls)
- Refrigerant R-11, R-12, R-113, R-114, R-500 and R-502

ATTEST (If Corporation)

_____

_____ _____

Secretary Name of Subcontractor / Supplier

By _____ Date _____

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

ASBESTOS FREE AFFIDAVIT

I understand that the IDEA Public Schools, in order to protect the students, staff and public in general from any unnecessary exposure to asbestos fibers, and to comply with the Asbestos Hazard Emergency Response Act prohibits the use of asbestos containing materials in all forms in the construction and operation of their facilities.

I certify that I am familiar with the materials used in the construction of, and incorporated into, the construction described below. I further certify that to the best of my knowledge and belief, no asbestos containing building materials (ACBM) either friable or otherwise were used in the process of construction or incorporated into the construction of the building.

DATE: _____

SCHOOL: _____

JOB DESCRIPTION: _____

_____

CONTRACTOR: _____

_____

_____ _____
Contractor's Signature Date

Failure to complete this waiver constitutes non-compliance with the job specifications and an unacceptable job.

Signed before me this ____ day of _____, 20____

_____
Notary Public

My commission expires: _____

As the architect and/or project engineer responsible for the above said project I certify that no asbestos containing building materials were specified as a building material in the building as specified in 40 CFR 763.99(a)(7).

_____ _____
Architect's or Project Engineer's Signature Date

Architect or Project Engineer Stamp

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

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 preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.

4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 019113 - 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:

1. General requirements for coordinating and scheduling commissioning.
2. Commissioning meetings.
3. Commissioning reports.
4. Equipment and systems installation, startup, and field quality-control testing indicated in the Contract Documents.
5. Use of test equipment, instrumentation, and tools for commissioning.
6. System readiness checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
7. Commissioning tests and commissioning test demonstration.
8. Work to correct commissioning issues.
9. Work to repeat tests when equipment and systems fail acceptance criteria.
10. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submittal procedures requirements for commissioning.
2. Section 017700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.
3. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal.
4. Section 220800 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.
5. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
6. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

1.3 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, system readiness checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.

B. Basis-of-Design Document (BoD): A document prepared by Engineer, or Commissioning Authority that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

C. Commissioning Authority (CxA): An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.

D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning.

E. Commissioning (Cx): A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of commissioning is defined in Section 011000 "Summary."

F. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date Construction Phase Commissioning Completion is achieved. See Section 017700 "Closeout Procedures" for certificate of Construction Phase Commissioning Completion submittal requirements.

1. Commissioning is complete when the work specified in this Section and related Sections has been completed and accepted, including, but not limited to, the following:
   a. Completion of tests and acceptance of test results.
   b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
   c. Comply with requirements in Section 017900 "Demonstration and Training."
   d. Completion and acceptance of submittals and reports.

G. 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

H. 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, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

I. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

J. Construction or System readiness 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.

K. Sampling: Functionally testing only a fraction of total number of identical or near identical pieces of equipment.

L. 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.

M. Simulated Condition: Condition created for purpose of testing response of system.

N. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

O. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

P. Trending: Monitoring using building control system.

1.4 COMPENSATION

A. Should Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.
1. Failure to provide timely notice of commissioning activities schedule changes.
2. Failure to meet acceptance criteria for test demonstrations.

B. Contractor shall compensate Owner for such additional services and expenses at the rate of $150.00 per labor hour plus $100.00 per round trip plus per diem allowances for meals and lodging according to current U.S. General Services Administration (GSA) Per Diem Rates.

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):
1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:
1. Commissioning Authority (CxA), plus consultants that CxA may deem appropriate for a particular portion of the commissioning.
   a. CxA: Ethos Engineering, Cesar Gonzalez, PE. Cell (956) 564.2827

2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning.

3. MEP Engineer, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning.
   a. MEP: Ethos Engineering, Guillermo Quintanilla. Cell (956) 564.2811.

1.6 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedures general requirements for commissioning.

B. Commissioning Plan Information:
   1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors to the performance of the various commissioning requirements.
   2. Schedule of commissioning activities, integrated with the construction schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for construction schedule general requirements for commissioning.
   3. Contractor personnel and subcontractors to participate in each test.
   4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:
   1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:

      a. Make inspections required for commissioning.
      b. Coordinate, schedule, and manage commissioning of Contractor, subcontractors, and suppliers.
      c. Obtain documentation required for commissioning from Contractor, subcontractors, and suppliers.
      d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Test Reports:
   1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed system readiness checklists.
   2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
   3. Commissioning Issues Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
   4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
   5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
   6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit print-out of log of alarms that occurred since the last log was printed.

G. System readiness checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:
1. At Construction Phase Commissioning Completion, include the following:

a. Pre-startup reports.
b. Test data forms, completed and signed.
c. Commissioning issues report log.
d. Commissioning issues reports showing resolution of issues.
e. Correspondence or other documents related to resolution of issues.
f. Other reports required by commissioning.
g. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction Phase Commissioning Completion.
h. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction Phase Commissioning Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

1.8 COMMISSIONING TEAM RESPONSIBILITIES

A. COMMISSIONING AUTHORITY: Responsibilities of the CxA during the Construction Phase include the following:
1. Coordinate and direct steps of the total Commissioning Process for systems being installed as part of this contract. Coordinate commissioning work schedule with Owner and Contractor.
2. Provide Commissioning Plan.
3. Attend planning and construction-site meetings as required to obtain information relating to Commissioning Process. Convene commissioning team meetings as required.
4. Plan and conduct commissioning scoping and coordination meetings. Provide notice to all Team members to attend scheduled commissioning meetings.
5. Request all information required for Commissioning Process from manufacturers, Contractor, and Design Professionals.
6. Review Design Professionals' design documents to gain clear understanding of design intent. (Not in scope)
7. Review submittals for compliance with commissioning needs. (Not in scope).
8. Verify that systems and equipment have been installed and started in accordance with manufacturer's recommendations and with generally recognized construction standards, and that documentation of such has been provided.
9. Assist in resolving discrepancies.

10. Prepare System readiness checklists to ensure systems have been installed according to project specifications. Verify that System readiness checklists have been addressed by Contractor and are accurate. Deliver final System readiness checklists to Owner.
11. Prepare Functional Test procedures to demonstrate performance of systems according to project specifications. Observe and document performance of systems, as per process detailed in Functional Test procedures.
12. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, system readiness checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
13. Prepare and maintain an Issues Log.
14. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.
15. Review testing and balancing (TAB) reports; notify Owner of deficiencies.
16. Recommend acceptance or non-acceptance of systems to Owner.
17. Verify that Operations and Maintenance (O&M) documentation is acceptable. Operations and Maintenance manuals shall be submitted simultaneously to CxA and to Design Professionals for review. (Not in scope)
18. Verify that training has taken place by collecting training documentation from Contractor.
19. Compile and maintain commissioning record.
20. Provide pre-final and final commissioning reports to all commissioning team members. The report shall include:
    a. Communications between Owner, CxA, Design Professionals, Vendors, and/or Contractor and Subcontractors related to Commissioning Process.
    b. Minutes of commissioning meetings.
    c. Findings and pertinent observations.
    d. A listing of any deficiencies, unresolved issues, and compromises in the environmentally responsive features
    e. Manufacturer's start-up reports.
    f. An Issues Log which:
        1) Describes design, installation, and performance issues which are at variance with the Owner's project requirements and Contract Documents.
        2) Identifies and tracks issues as they are encountered, documenting the status of unresolved and resolved issues.
        3) Documents corrective modifications made.
    g. System readiness checklists.
    h. Testing plans and Functional Test reports.
    i. Listing of off-season test(s) not performed and a schedule for their completion.
21. Conduct an inspection of the building and its systems within 10 months after substantial completion and prior to the expiration of warranties. Prepare a report documenting findings that should be addressed prior to expiration of warranties.

B. CONTRACTOR: Responsibilities of the General Contractor (GC) as related to Commissioning Process include, but are not limited to the following:
1. Facilitate coordination of Commissioning work by CxA.
2. Attend Commissioning meetings or other meetings called by CxA to facilitate the Commissioning Process.
3. Integrate and coordinate commissioning process activities with construction schedule.

4. Review CxA's Functional Test procedures for feasibility, safety, and impact on warranty, and provide CxA with written comment on same.
5. Provide all documentation relating to manufacturer's recommended performance testing of equipment and systems.
6. Provide Operations and Maintenance Data to CxA for preparation of checklists and training manuals.
7. Provide testing and balancing report.
8. Provide As-built drawings and documentation to facilitate Functional Testing.
9. Assure and facilitate participation and cooperation of specialty subcontractors (electrical, mechanical, Building Automation, etc.), and equipment suppliers as required for the Commissioning Process.
10. Require subcontractors to inspect systems installed and fill-out System readiness checklists (provided by CxA) to verify installation has taken place in accordance with manufacturer's instructions, and in a workmanlike manner in accordance with project documents and generally accepted construction practices. Certify to CxA that installation work listed in System readiness checklists has been completed and accompany CxA during verification of completed System readiness checklists.
11. Install systems and equipment in strict conformance with project specifications, manufacturer's recommended installation procedures, and System readiness checklists, as prepared by CxA.
12. Provide data concerning performance, installation, and start-up of systems.
13. Provide copy of manufacturer's filled-out start-up forms for equipment and systems.
14. Ensure systems have been started and fully checked for proper operation prior to arranging for Functional Testing with CxA. Prepare and submit to CxA written certification that each piece of equipment and/or system has been started according to manufacturer's recommended procedure, and that system has been tested for compliance with operational requirements.
    a. GC shall carry out manufacturer's recommended start-up and testing procedures, regardless of whether or not they are specifically listed in CxA's Functional Test procedures.
    b. GC is not relieved of obligation for systems / equipment demonstration where performance testing is required by specifications, but a Functional Performance Test is not specifically designated by CxA.
15. Coordinate with CxA to determine mutually acceptable date of Functional Performance Tests.
16. Review and accept construction checklists provided by the CxA.
17. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.
18. Complete commissioning process test procedures.
19. Provide qualified personnel to assist and participate in Commissioning.
20. Provide test instruments and communications devices, as prescribed by CxA and where identified in this specifications manual, as required for carrying out Functional Testing of systems.
21. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
22. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
23. Ensure deficiencies found in the Commissioning Process are corrected within the time schedule shown in the CA report.
24. Provide CxA with all submittals, start-up instructions manuals, operating parameters, and other pertinent information related to Commissioning Process. This information shall be

provided directly to the CxA as a digital PDF file at the same time that the submittals are made to the architect and/or engineer.

25. Prepare and submit to CxA proposed Training Program outline for each system.
26. Coordinate and provide training of Owner's personnel. Provide CxA with proposed training agenda no less than 14 days prior to scheduled training sessions. Provide documentation that training took place (including system being trained on, trainer's name and contact information, sign-in sheet verifying who attended training, length of training, and signature of owner's authorized person certifying training took place satisfactorily).
27. Prepare Operation and Maintenance manuals and As-Built drawings in accordance with specifications; submit copy to CxA in addition to other contractually required submissions. Revise and resubmit manuals in accordance with Design Professionals and CxA's comments.
28. 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. Subcontractors and vendors shall prepare and submit to Commissioning Authority Manufacturer's installation and performance test procedures to demonstrate performance of systems according to these specifications and checklists prepared by Commissioning Authority.

D. Owner's Representative: Responsibilities of the Owner's Representative as related to Commissioning Process include, but are not limited to the following:
1. Provide the OPR documentation to the CxA and GC for information and use.
2. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
3. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and GC for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.
4. Manage contracts of Architect and GC.
5. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
6. Provide final approval for completion of Commissioning Work.
7. Warranty Period: Ensure that seasonal or deferred testing and deficiency issues are addressed.

E. Architect: Responsibilities of the Architect as related to Commissioning Process include, but are not limited to the following:
1. Attend commissioning scoping meeting and other commissioning team meetings as requested by Commissioning Authority and as selected by Architect.
2. Perform normal submittal review, construction observation, record drawing preparation, and operations and maintenance data preparation, as required by Contract Documents.
3. Review Commissioning Authority's submittal review comments and issue directive to GC and/or Design Professionals as deemed applicable. (Not in CxA's scope to review submittals).
4. 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.
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.

F. Design Professionals Responsible for Design of Each Portion of Work Being Commissioned:
1. Perform normal submittal review, construction observations, and record drawing preparation, as required by Contract Documents. Perform site observation immediately preceding system startup.
2. Respond to deficiencies identified by Commissioning Authority as directed by Architect.
3. Provide design narrative and sequence documentation requested by Commissioning Authority. 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.
4. Attend commissioning scoping meetings and other commissioning team meetings as requested by Commissioning Authority and as selected by Architect or responsible design professional.
5. Participate in resolution of system deficiencies identified during commissioning, as required by Contract Documents.
6. Prepare and submit final as-built design intent and operating parameters documentation for inclusion in Operation and Maintenance Manual, and review and approve Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.

2.2 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:
1. Retain first two subparagraphs below for projects requiring hard-copy submittals; delete for projects requiring only electronic submittals.
2. Bind report in three-ring binders.
3. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
4. Record report on compact disk.
5. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:
1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:

a. Test specification.
b. Pre-startup reports.
c. Test data forms, completed and signed.
d. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review preliminary system readiness checklists and preliminary test procedures and data forms.

3.2 GENERAL

A. Authority
1. The Commissioning Authority carries out the Cx responsibilities as the Owner's authorized agent in accordance with plans, specifications, and contractual requirements.
2. CxA reports deficiencies found to the GC, Architect and Owner.
3. The Architect 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 Architect 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. Attend initial commissioning team scoping meeting, pre-commissioning meetings specific to each system, and other meetings requested by CxA as required to discuss resolution of deficiencies.
5. Coordinate with sub-Contractors and equipment vendors/representatives to set aside adequate time to address System readiness Checklists, Functional Testing, Operations and Maintenance Training, and associated coordination meetings.

C. Work Prior To Testing
1. A commissioning team scoping meeting shall be held at a time and place designated by Commissioning Authority. Owner, Architect, Commissioning Authority, Contractor, and Mechanical, Electrical, and Controls Contractors, shall be present at this meeting. The main objectives of the meeting are to familiarize all parties with the requirements of the

commissioning process; to ensure that the responsibilities of each party are clearly understood; and obtain information to develop the preliminary commissioning plan, including:

a. Personnel representing the various entities participating in the process (GC, subcontractors, Owner, Architect, Engineer, CxA)
b. Lines of communications;
c. Assignment of responsibilities;
d. Review system readiness checklists;
e. Submittal schedule;
f. Preliminary construction schedule

2. Following the initial commissioning team scoping meeting, and upon reviewing submittals, CxA shall prepare a preliminary Commissioning Plan outlining procedures and responsibilities, including names and contact information of responsible parties, tentative dates for commissioning activities, and system readiness checklists. Preliminary Commissioning Plan shall be distributed to GC and Owner electronically for review and comment. CxA shall modify the Commissioning Plan based on feedback from GC and Owner and will generate a final Cx Plan.
3. Prior to system readiness 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 issued by Architect 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 fourteen (14) days prior to date of system readiness performance test, submit to Commissioning Authority for review, detailed description of equipment start-up procedures which GC proposes to perform to demonstrate conformance of systems to specifications and commissioning checklists.
7. Convene system-specific pre-commissioning meetings prior to start of system readiness testing of each system. The GC shall hold a pre-commissioning meeting with all Team members in attendance. The purpose of the meeting is to review the system readiness checklists, and equipment start-up procedures for each system to be commissioned, confirm that systems are ready for testing, and define a schedule for testing activities.

D. System readiness 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 system readiness checks and functional performance tests. A system readiness 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.

3.3 SUSTAINABILITY REQUIREMENTS

A. Comply with requirements listed in specifications and drawings as it relates to sustainability features that will be verified during the Commissioning process.

3.4 SYSTEM READINESS CHECKLISTS

A. General
1. System readiness checklists are important to ensure 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 system readiness 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 system readiness checklist was performed shall initial or check item off.
4. Each piece of equipment and major distribution system receive full system readiness checkout. No sampling strategies are used.
5. System readiness checkout for given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of given system.

B. System readiness Checklist
1. System readiness 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 System readiness 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. Do not conduct start-up procedure recommended by equipment/system manufacturer at prior to system readiness testing.
7. Subcontractors shall clearly list outstanding items of initial start-up and system readiness procedures that were not completed successfully at bottom of procedures form or on separate sheet attached to form. Completed forms and attached sheets shall be provided to Commissioning Authority within 2 days of test completion. Installing subcontractor or vendor shall correct deficient or incomplete areas in timely manner and shall submit updated system readiness checklist and startup report with statement of correction on original non-compliance report.
8. When system readiness checklists for a particular system or subsystems are completed, GC will request verification by CxA. GC and subcontractors shall accompany CxA during system readiness checklist verification.
9. If during system readiness checklist verification, CxA finds a significant number of deficiencies, GC shall have all the checklists associated with similar system redone.

3.5 SYSTEM START-UP

A. GC will arrange for start-up of operating equipment and systems after (or at the same time as) system readiness testing and prior to scheduling Functional Testing.

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 Functional Testing.

3.6 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 his 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 system readiness 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 system readiness 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 System readiness 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 System readiness 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 noted above), and such

remaining deficiencies are significant enough to require additional inspection or re-testing, GC will be back-charged for CxA's expenses, per Article 1.5.

3.7 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.

3.8 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.

3.9 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 Architect.

C. CxA shall review O&M Manuals and submit comments through the Architect.

3.10 SYSTEMS TO BE COMMISSIONED

A. Refer to commissioning specifications sections in Related Sections, including the following:
1. 230100 - COMMISSIONING OF MECHANICAL SYSTEMS

END OF SECTION 019113

SECTION 033000 – CAST-IN-PLACE CONCRETE (LIMITED APPLICATIONS)

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 specifies cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.3 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete mix.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.
   1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
   2. Formwork and form accessories.
   3. Steel reinforcement and supports.
   4. Concrete mixtures.
   5. Handling, placing, and constructing concrete.

PRODUCTS

2.1 FORMWORK

A. Furnish formwork and form accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Types I or II or Type I/II.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1.5 in nominal size.

C. Water: Potable and complying with ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

2.5 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 CONCRETE MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Compressive Strength (28 Days): 3000 psi.
2. Slump: 2 inch minimum to 5 inch maximum.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6.0 percent within a tolerance of plus 1.0 or minus 1.5 percent.

1. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94 and ASTM C 1116.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

3.2 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.3 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Architect.

3.4 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Consolidate concrete with mechanical vibrating equipment.

3.5 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

3.6 TOLERANCES

A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.
   1. Testing Frequency: Obtain at least 3 cylinders for each 50 cu. yd. or fraction thereof of each concrete mix placed each day.

3.9 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 033000

SECTION 099000 – PAINTING

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 surface preparation and field painting of the following:
   1. Piping and piping accessories and supports
   2. Exposed ductwork and accessories

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

   1. Painting includes field painting of exposed bare and covered pipes (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

   1. Operating parts include moving parts of operating equipment and the following:

      a. Valve and damper operators.
      b. Linkages.
      c. Sensing devices.
      d. Motor and fan shafts.

   2. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

   1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1.6 PROJECT CONDITIONS

A. Apply paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.

B. Do not apply paint in rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
1. Glidden Co. (The) (Glidden).
2. Sherwin-Williams Co. (S-W).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Colors: Match colors indicated by reference to manufacturer's color designations.
1. Condenser Water: To be coordinated with Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

    a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
    b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
    c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
5. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:
   1. Piping, pipe hangers, accessories and supports.
   2. Exposed ductwork, plenums, accessories and supports.

G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

3.6 PAINT SCHEDULE

A. Ferrous Metal: Semi-Gloss, Alkyd-Enamel Finish: 2 finish coats over an enamel undercoat and primer.
   1. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils. S-W: Kem Kromik Universal Metal Primer B50NZ6/B50WZ1.
   2. Undercoat: As recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils. S-W: High-Solids Poly-Urethane Semi-Gloss B65 350 Series, with Hardner: B60V30.
   3. Finish Coat: Same as undercoat. Semi-gloss, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils

SECTION 099000 – PAINTING

END OF SECTION 099000

SECTION 230010 – SUMMARY OF MECHANICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 23 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, and is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

B. Mechanical Contract Documents were prepared for the Project by:
Ethos Engineering,
1126 South Commerce Street
Harlingen, Texas 78550
Phone Number: (956) 230-3435

C. Proposals are organized as follows:
1. Base Proposal: With ALC WebCTRL Controls
2. Alternate Proposal # 1: Identical scope as Base Bid, except with JCI Metasys Controls

D. Scope of Work: Refer to drawings.
1. Provide all materials and labor associated with new fully-operational mechanical and controls systems for the project "CSP#16-SBHVAC-1226 San Benito HVAC/Controls", including but not limited to the following:
2. Retain and reuse existing DX AHUs, VAV boxes, EFs and related ductwork as noted on the drawings.
3. Where indicated, save existing power and control wiring, conduits, and circuit breakers for reuse. Verify size and condition of circuit breakers, conduits and wiring to be reused.
4. Save existing smoke detectors, wiring and safeties for reuse. Document devices that are not in working order
5. Design intent is to retain and reuse existing refrigerant piping and supports. Verify that line sizes are appropriate and approved by manufacturer of HVAC equipment.
   a. Evacuate refrigerant, clean it, and deliver to Owner.
   b. Nitrogen-purge. Pressure-test circuits with dry nitrogen to verify there are no leaks.
   c. After passing the pressure test, perform a deep evacuation (preferably with a nitrogen sweep/triple evacuation on large systems) to below 500 microns, verify the vacuum holds, and then recharge with new refrigerant.
   d. Remove insulation and prepare piping for re-insulation and jacketing.
6. Demolition Work: Demolish listed equipment and materials. The Owner has the right of first refusal. Dispose of removed items that the owner no longer wishes to keep.
   a. Remove listed air handling units, air-cooled condensing units, refrigerant specialties, miscellaneous HVAC, electrical, and controls equipment and materials.
   b. Where refrigerant piping cannot be reused, remove piping, piping supports, as indicated in plans to make room for new equipment.

c. Demolish electrical equipment and other miscellaneous materials as noted s.
d. Demolish controls in their entirety.
e. Clear area and prepare for new work.

7. New Work: Provide all materials and labor associated with new fully operational mechanical and controls systems, including but not limited to the following:
   a. Air handling units, to match with existing ACCUs that are retained and reused
   b. Air-cooled condensing units to match existing AHUs that are retained and reused.
   c. Provide related electrical, and controls.
   d. Provide modification of ductwork, refrigerant piping (where indicated), piping supports, insulation, controls, and electrical systems.
   e. New piping specialties, pipe insulation, jacketing, and miscellaneous accessories.
   f. New Building Automation System (BAS) controls for all existing, and new equipment, including controllers, sensors, damper actuators for OA, RA, bypass, relays, graphics, sequences, programming, etc. Coordinate BACnet points for new equipment. Commission controls sequences.
   g. All other accessories to deliver a complete and operational system.
   h. Testing, adjusting, and balancing.
   i. Cutting and patching and touchup painting as required.
   j. Concrete work as needed.
   k. Shop drawing submittals for all mechanical systems including but not limited to equipment, ductwork and piping. These include coordination drawings for placing of mechanical systems in relation to work by other disciplines.
   l. Windstorm restraints for exterior mounted equipment, along with sealed drawings and calculations showing that restraints meet IBC requirements.
   m. Coordinate electrical work with Div. 26 as required.
   n. Coordinate fire alarm related work with Fire Alarm Contractor. Provide smoke detectors, wiring and controls for units, 2000 cfm and larger, where none exist.
8. Painting: See Division 9 specifications. Paint all exposed piping, ductwork, insulation, hangers, accessories in interior exposed areas. Paint exterior pipe supports. Coordinate paint type, color and scope of work with Architect.
9. Commissioning: Provide assistance with commissioning services per specifications. This includes completing systems readiness checklists, performing functional testing, providing operator training, etc.

1.3 ALLOWANCES

A. Allowances are included in Division 1 specifications.

1.4 COORDINATION

A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, who is ultimately responsible for the entire project.

B. Prior to bidding, Mechanical Contractor shall coordinate all work in Division-23 for integration with plumbing, electrical, controls work and general construction. A detailed list of inclusion and exclusions shall be provided to General Contractors at least three days prior to the end of the period set aside to request clarifications so that coordination of any missing items may be addressed and clarified by Architect/Engineer as needed.

C. All electrical work required for operation of mechanical systems shall be coordinated through the General Contractor prior to bidding to ensure that all starters, disconnects, VFD's, conduit and wiring are provided as part of the project. All components needed for a full operational installation of systems shall be provided.

D. All controls required for operation of mechanical systems shall be coordinated prior to bidding, to ensure that all equipment, materials, sensors, devices and labor are provided as part of the project. All components needed for a full operational installation of systems shall be provided. Mechanical Contractor shall coordinate and supervise installation of all controls systems.

E. All questions, requests for information, submittals, and correspondence from the Div. 23 Contractor shall be submitted via the General Contractor, who will forward to the Architect, who will then forward to the Engineer.

F. Div. 23 Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Architect, General Contractor, Suppliers, Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.

G. Div. 23 Contractor shall issue seven days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered.

H. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Ensure that systems are ready for controls and electrical connections when needed so as to not delay construction.

I. Contractor shall coordinate with other divisions for power and control of mechanical systems. It is not the intent of this specification to dictate who will conduct work, only to state the requirements of conducting the work.

J. Coordinate with Div. 1 for work sequence and optimization of construction schedule.

K. Coordinate with Div. 21 for Fire Suppression System.

L. Coordinate with Div. 22 for Plumbing System.

M. Coordinate with Div. 26 electrical contractor for providing power to mechanical equipment, and for Fire Alarm Systems interface with mechanical systems.

N. Coordinate commissioning activities with Commissioning Authority.

O. Coordinate TAB activities with TAB Contractor.

P. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is contractor's responsibility to make sure Engineer receives notification.
   1. Upon completion of underground piping installation and prior to testing or covering up.
   2. Upon completion of all water piping installation and prior to insulation and/or testing.
   3. Upon completion of ductwork and prior to testing and insulating.

4. Metal duct leakage testing.
5. Above ceiling inspections prior to ceiling tile installation.
6. When ready to request manufacturer's start-up of each piece of equipment.
7. When ready for an inspection by TAB contractor prior to developing detailed TAB Plan.
8. When ready to conduct complete Automation System software demonstration.
9. When ready for Systems Readiness Checklists (Commissioning).
10. When ready for Functional Performance testing (Commissioning).
11. When ready for Substantial Completion Inspection.
12. Training.
13. When ready for Final Inspection.

Q. General

1. The Contractor shall execute all work hereinafter specified or indicated on accompanying Drawings. Contractor shall provide all equipment necessary and usually furnished in connection with such work and systems whether or not mentioned specifically herein or on the Drawings.
2. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation.
3. The Mechanical, Electrical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
4. When the mechanical, electrical and plumbing drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

1.5 WORK SEQUENCE

A. Locate Utilities:

1. Coordinate with power, water, sewer, telephone, communications, and other utilities as well as designated Owner's personnel to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

4. Where several new utilities must share a common area or path, coordinate with other trades so that the proper clearances are maintained and utilities may be installed in compliance with all requirements.
5. Refer to Civil Plans for coordination of connection points from site utilities to buildings.

B. Coordinate with Division 1 requirements to optimize construction schedule.

C. Provide equipment and material submittals, coordination drawings and shop drawings as required by specifications.

D. Submit detailed mechanical Schedule of Values with Submittals. Mechanical Submittals will not be accepted without a detailed Schedule of Values.

E. Sequence construction in coordination with work by other disciplines.

1.6 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
1. Driveways and Entrances: Keep driveways and entrances to construction site clear and available to other Contractors, Owner, and A/E personnel at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

1.7 SUBMITTALS

A. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information which is not applicable to the equipment being supplied for this project.

B. Provide all mechanical submittals at the same time in one or multiple bound volumes. Include originals from manufacturer. All submittals shall be in native pdf and searchable format. Faxes and copies of faxes are not acceptable.

C. Provide sufficient copies of approved data, with the engineer's approved stamp, for inclusion in the operations and maintenance manuals.

D. Provide detailed coordination drawings showing how mechanical system components will be installed in coordination with work by others. Engineer's drawing files will be made available to Contractor for producing coordination and as-built drawings upon request.

1.8 SCHEDULE OF VALUES -Special Requirements

A. Mechanical Contractor shall submit a Schedule of Values reflecting the total value of Mechanical Work in the Contract, and broken down into the following items as a minimum, with a line-item for Materials/Equipment and another for Labor:

MECHANICAL

1. HVAC equipment
2. HVAC materials (ductwork, piping, dampers)
3. HVAC labor
4. Controls equipment
5. Controls labor
6. Controls engineering and programming
7. Controls commissioning and closeout (minimum 10% of total controls cost)
8. Controls training (minimum 5% of total controls cost)
9. TAB
10. Commissioning
11. Allowances
12. Miscellaneous
13. Administrative and project management

B. Schedule of Values shall be included with bound submittals. Submittals without a Schedule of Values shall not be reviewed.

1.9 EQUIPMENT MANUFACTURERS

A. Mechanical design is based on equipment and materials scheduled and specified. These are used as the basis for performance characteristics, quality, and physical dimensions/weight.

B. Equipment and materials by other APPROVED manufacturers may be provided by Contractor. In doing so, Contractor assumes responsibility for the performance, quality, and physical dimensions of the proposed units.

C. Any costs associated with modifications to the design due to submittal of equipment and/or materials other than those used as the basis of design are the Contractor's responsibility. This includes any design time, production of drawings, and time delays.

D. Where use of equipment and/or materials other than those used as the basis of design impact other disciplines, Contractor shall assume responsibility for all costs associated with any APPROVED modifications. This may include resizing of electrical circuits, modifying openings in the structure, relocating floor drains, etc.

1.10 OPERATIONS AND MAINTENANCE MANUALS & TRAINING

A. Submit Operations and Maintenance Manuals two weeks prior to Substantial Completion Inspection. Engineer will not conduct a Substantial Completion Inspection without having reviewed Operations and Maintenance Manuals.

B. Use Operations and Maintenance Manuals as a guide for conducting training of Owner's personnel.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 230010

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque. Unless otherwise noted, windings shall be:

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers:

1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch 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 Section 079200 "Joint Sealants."

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 Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
   4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 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.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade: Cast-iron wall sleeves.
   2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   4. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves.
   5. Interior Partitions: Galvanized-steel-pipe sleeves.

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.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 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.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
   f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with rough-brass finish.

2. Escutcheons for Existing Piping:
   a. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
   b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
   f. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
   g. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

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. New Piping: One-piece, floor-plate type.
   2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

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. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" and Section 233116 "Nonmetal 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. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

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.

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.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
   1. Manufacturers:
      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 inturned lips.
   5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
   6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   7. Metallic Coating: Hot-dipped galvanized.
   8. Paint Coating: Epoxy.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

B. Insulation-Insert Material for Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- 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.

2.6 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: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 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, 28-day compressive strength.

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 Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. 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.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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 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 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: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. 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 trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/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 1-1/2 inches.

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.

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 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. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
3. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
4. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
5. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
6. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
7. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. 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.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. 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. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Housed-restrained-spring isolators.
5. Elastomeric hangers.
6. Spring hangers.
7. Vibration isolation equipment bases.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548.13 "Vibration Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

D. Wind-Restraint Details:

1. Basic Wind Speed: Refer to Arch.
2. Building Classification Category: Refer to Arch.
3. Code recommended wind pressure multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
4. Design Analysis: To support selection and arrangement of **wind** restraints. Include calculations of combined tensile and shear loads.
5.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Provide operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: Ribbed or Waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Ribbed or Waffle pattern.
b. Infused nonwoven cotton or synthetic fibers.

C. Double-Deflection, Elastomeric Isolation Mounts:
1. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

D. Restrained Elastomeric Isolation Mounts
1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

E. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top plate with threaded mounting holes elastomeric pad.
c. Internal leveling bolt that acts as blocking during installation.

2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

H. 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. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

J. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

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 of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 Sections.

3.4 VIBRATION-CONTROL AND WIND-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Install cables so they do not bend across edges of adjacent equipment or building structure.

C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust active height of spring isolators.

END OF SECTION 230548.13

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.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

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.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
   5. Fasteners: Stainless-steel rivets or self-tapping screws.
   6. 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), and 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 bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full 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; also include 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 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

E. Fasteners: Stainless-steel rivets or self-tapping screws.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include 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 high.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Description: 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 minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-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 GENERAL INSTALLATION REQUIREMENTS

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.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Division 09 Sections.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe Label Locations: 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 and on both sides of 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule: Coordinate with Owner.

3.5 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes: Coordinate with Owner.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 PAINTING

A. Clarification: In exposed areas (with no acoustic ceiling tiles), piping and piping insulation shall be painted. Although Division 9 may not specifically call for painting of MEP items, it states paint type and requirements for different materials. To extent possible coordinate painting with Division 9 and with Architect. Where adequate specifications are not available, use the following general guidelines:
   1. Ferrous Metal: Semi-Gloss, Alkyd-Enamel Finish: 2 finish coats over an enamel undercoat and primer.
      a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils. S-W: Kem Kromik Universal Metal Primer B50NZ6/B50WZ1.
      b. Undercoat: Alkyd, interior enamel undercoat or semi-gloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils. S-W: Pro-mar 200 Interior Alkyd Enamel B34W200 Series.
      c. Finish Coat: Same as undercoat. Semi-gloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
   2. ASJ Jacket: Semi-Gloss, Acylic-Enamel Finish: 2 finish coats.
      a. Undercoat: Semi-gloss acrylic latex enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 mils. S-W: Pro-Mar Interior Latex Egg-Shell Enamel B20W200.
      b. Finish Coat: Same as undercoat. Semi-gloss, acrylic latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils

B. Final colors shall be coordinated with Owner and Architect during construction.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. TAB work shall not be contracted under Division 23 Contractor. Third party TAB Contractor shall be contracted by the Prime Contractor. Coordinate activities and assist TAB Contractor as needed.

B. Background and Scope of Work: Project includes replacement of DX AHUs, DX ACCUs, and complete controls upgrade. See Summary of Work.
   1. Provide TAB services for the complete split systems that are receiving new DX equipment, and controls, including rebalancing of the existing AHUs that are to remain.
   2. In addition, provide TAB services for existing VAV boxes to remain, that will receive new controllers. Provide a detailed list of deficiencies related to existing dampers, actuators, flow rings, and their operation. Owner will address and correct the deficiencies under an allowance. Provide TAB services of the repaired equipment, as needed.
   3. Rebalancing existing air devices, downstream of the VAV boxes, is not necessary.

C. Section Includes:

   1. Balancing Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.

   2. Testing, Adjusting, and Balancing Equipment:
      a. Motors.
      b. Heat-transfer coils.

   3. Testing, adjusting, and balancing existing systems and equipment.
   4. Duct leakage tests.
   5. Control system verification.
   6. Other tests as specified.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETING

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:
   a. The Contract Documents examination report.
   b. The TAB plan.
   c. Needs for coordination and cooperation of trades and subcontractors.
   d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.
1. Standard report forms from AABC, NEBB, or TABB are acceptable.
2. Report forms from other than AABC, NEBB, or TABB may be acceptable even if organized differently, but must contain the same essential information.

C. Sample report forms.

D. Instrument calibration reports, to include the following:
1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.
1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

A. The Owner will occupy portions of existing buildings Owner will occupy the site and existing building during entire TAB period. Reference SECTION 011000 - SUMMARY for more precise dates and stipulations.

B. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. At least 15 calendar days prior to any on-site TAB measurements taking place, prepare and submit to Engineer a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. **Measure static pressure across heat transfer coils and other system components as detailed in paragraphs for HEAT-TRANSFER COILS to follow.**
d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.

5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

E. To obtain scheduled outside air (OA) flow rates: Balance OA and RA dampers at the unit to get scheduled OA Flow CFM at fan speeds (low and high). Coordinate OA and RA dampers with BAS Controls Contractor.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:
1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

B. To obtain scheduled outside air (OA) flow rates for AHUs with Variable Frequency Drives: Balance OA and RA dampers at the AHUs to get scheduled OA Flow CFM at fan speeds of 100%, 50%, and 30%. Coordinate OA and RA dampers with BAS Controls Contractor.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.
   1. Verify VFD controller is keeping correct time/date and maintains it after restoration of power outage.
   2. Reduction in VFD speed from 60hz is to be the initial means of balancing systems. It is not acceptable to operate VFD at 60hz (or higher) and then balance system by throttling valves or dampers. Throttle flow(s) to outlet devices (e.g. coils, air devices, etc.) only after VFD has been reduced to lowest speed required to provide design flow.
      a. Set the maximum required VFD speed at VFD controller, and report speed in final TAB report.
   3. Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Phase and hertz.
   4. Nameplate and measured voltage, each phase.
   5. Nameplate and measured amperage, each phase.

B. Verify proper rotation of fans.

3.9 PROCEDURES FOR REFRIGERANT HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data **for each DX, cooling and heating coils**:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.
      a. Units 6 tons and less: Overall readings (upstream of filters, fan suction, fan discharge) are to be taken for all units. A full test of air pressure drops across every single component of the system (i.e. filters, coils) need be taken only for a representative sample of units as follows:

Qty of units Installed	Full Testing
1-10	1
10-20	2
20-30	3
31+	4

      b. Units larger than 6 tons: Readings across **all system components** are to be taken for all units larger than 6 tons.

B. Where a unit has multiple coils (e.g. main cooling coil and a reheat coil), take and record data for each coil under conditions as close as possible to intended design operation (e.g., with cooling coil producing control-system sub-cooling setpoint, reheat coil producing control-system supply temperature setpoint).

C. Measure, adjust, and record the following data for each electric heating coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

3.10 DUCT LEAKAGE TESTS

A. Duct leakage testing will be performed by mechanical installation contractor.

B. Witness the duct pressure testing and provide written report on results immediately thereafter.
   1. Verify that proper test methods are used and that leakage rates are within specified tolerances.
   2. Report results of all testing and any deficiencies observed. Provide floor plans in report indicating sections of duct tested, and test criterion.

3.11 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

D. Data may be trended using Building Automation System. However, calibration of DDC sensors must be verified prior to trending data.

3.12 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.

B. Observe and record the following conditions for each HVAC system:
   1. The distance between the outside-air intake and the closest exhaust fan discharge, flue termination, or vent termination.
   2. Specified filters are installed. Check for leakage around filters.
   3. Cooling coil drain pans have a positive slope to drain.
   4. Cooling coil condensate drain trap maintains an air seal.
   5. Evidence of water damage.
   6. Insulation in contact with the supply, return, and outside air is dry and clean.

3.13 CONTROLS VERIFICATION

A. Measure accuracy of all sensors (temperature, humidity, dewpoint, pressure, carbon dioxide (CO2), etc.) associated with air conditioning systems and the Building Automation System (BAS).

B. At direction of Engineer, BAS and/or HVAC systems providers will be required to replace or calibrate sensors based upon this TAB sensors accuracy report. Subsequent to such replacement and calibration, re-measure accuracy of those sensors which were calibrated or replaced and submit report per directions above.

C. In conjunction with system balancing, perform the following:
   1. Temperature, pressure, CO2, relative humidity (RH) sensors.
      a. Obtain submittal information regarding manufacturer's claimed sensor accuracy.
      b. Verify that all sensors are reading within accuracy limits of manufacturer's claimed sensor accuracy, or accuracy required in specifications, whichever is the more stringent. This includes sensors supplied by controls company, those installed in spaces, in ductwork, in piping, and those which come integral to HVAC equipment manufacturer or supplied by HVAC equipment manufacturer. Use measuring instrument, calibrated within past year, of higher accuracy than sensor being tested.
         1) Accuracy of temperature and RH sensors may be verified at one single reading, i.e. the temperature or RH of the room or substance at the time the sensor is being checked.
         2) Verify accuracy of pressure sensors at no flow condition (i.e. unit off), and when unit is operating.
         3) Verify two-point accuracy of CO2 sensors: 1, at Low end, where room has been unoccupied for a long period of time; CO2 should be near 400ppm; and 2, at High end, a time when room is or has been occupied such that CO2 has risen to 700ppm or more. (This second measurement may need to take place after building is occupied, i.e. during the 90 day follow up visit. For rooms which are 'permanently' unoccupied, High end reading need not be taken.)
      c. Verify sensors are installed and in locations appropriately for intended use; list observations regarding sensors installation which may impact satisfactory operation of HVAC systems. (For examples: verify that room temperature sensors are installed in a location appropriate for space (e.g., not on exterior wall, not exposed to sun, not above heat generating equipment, etc.); verify readings of unit return air sensors are not impacted by outside air intake.)

   2. Verify the following:
      a. Operation of valves, dampers, and associated actuators.
      b. Temperature control system is operating within the design limitations.
      c. Operation of lockout or interlock systems.
      d. Damper leakage is in accordance with submitted performance and does not prevent system operation in accordance with design intent.
      e. Leakage through valves is no greater than submitted leakage rate.

   3. Verify that controlled devices are properly installed and connected to correct controller.
   4. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.

5. Confirm that the sequences of operation are in compliance with Contract Documents.

3.14 REPORT ON SENSOR ACCURACY

A. Prepare a stand-alone report on sensor accuracy findings, as detailed in 'CONTROLS VERIFICATION'. Submit to General Contractor, Mechanical Contractor, Architect, Engineer, and Commissioning Agent (**CxA**).
   1. Report must be delivered promptly after sensor testing is complete in order that BAS contractor and/or equipment suppliers may replace faulty sensors before commissioning functional testing begins.

B. List every sensor tested, and indicate which room or equipment item it is associated with. Provide observations regarding sensors installation which may impact satisfactory operation of HVAC systems, such as improper location of sensors. List:
   1. Specified or submitted sensor accuracy, whichever is more stringent.
   2. Initial sensor reading re BAS or equipment controller.
   3. Sensor reading re TAB company's calibrated instrument.
   4. Required Offset, if sensor is within specified/submitted accuracy.
      a. Any sensors which require an "offset" by controller which is greater than required accuracy will be replaced by supplier.

C. TAB may create table formatting to display required data. A sample proposed format provided below for several types of sensors.

Required Sensor Accuracy
Space temperature sensors: ±0.75deg F
Space RH sensors: ±2%
Space CO2 sensors: ±30 PPM + 3% of reading
etc….

CO2 Sensor Low-Side Readings

Location	Sensor Reading	TAB Reading	Required Offset	Comment
RTU-310 space	340ppm	407ppm	-	REPLACE
RTU-311 space	388ppm	410ppm	+22ppm	
RTU-Café E ret air	290ppm	425ppm	-	REPLACE

Space Temperature Sensor Readings

Location	Sensor Reading	TAB Reading	Required Offset	Comment
Rm 123	73.4F	73.6F	0F	
Rm 124	73.0F	74.3F	1.3F	

Return Air Temperature Sensor Readings

Location	Sensor Reading	TAB Reading	Required Offset	Comment
RTU-310	69.5F	74.5F	-	REPLACE
RTU-311	70.5F	71.5F	+1.0F	

3.15 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

C. **Provide copy of reports to Contractor, Engineer, and Commissioning Agent.**

3.17 FINAL REPORT

A. Format

   1. **Report must be submitted in digital electronic format, in a fully searchable .pdf file.** Reports which are non-searchable or which contain scans of paper copies will be returned un-reviewed.
   2. Bookmark report to indicate major sections and individual HVAC units.

B. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

   1. Title page.
      a. Date the report is submitted must be on cover page.
      b. Project name.
      c. Project location.
      d. Name and address of General Contractor, Mechanical Contractor (if TAB is subcontractor to Mechanical), and TAB Contractor.
      e. Name and contact information for TAB Contractor’s representative.
      f. Architect’s and Engineer's name and address.

   2. Table of Contents.

   3. Certifications.

a. Certificate of TAB certifying agency.
b. Work Guaranty.
c. Signature of TAB supervisor who certifies the report.

4. Instrument Calibration Reports:
   a. Instrument type and make.
   b. Dates of use.
   c. Dates of calibration.
5. List of abbreviations used in report.
6. Nomenclature and data sheets for each item of equipment, including manufacturer's name, type, size. Include, at minimum:
   a. Fan curves.
   b. Manufacturers' test data.
   c. Field test reports prepared by system and equipment installers.
   d. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. Final Report Contents: In addition to items listed above, include:
1. Original test report of sensor accuracy testing.
2. Duct leakage test report.
3. Summary of observations on proper drainage of condensate drain pans for every item of equipment having a condensate drainage system.
   a. Proper pan slope and pan condensate evacuation.
   b. Adequate condensate trap depth versus static requirement.
   c. Adequate slope and lack of ‘bellies’ in condensate pipe drainage system.
   d. Proper pumped condensate operation.
4. Field observations list of conditions of filters (verify construction filters are removed and final filters are clean) and filter racks.
5. Field measurements and observations regarding leakage of outdoor air and control air dampers.
6. Certified field-report data for each balanced system, including specified versus final performance, notable characteristics of systems, description of system operation sequence if it varies from the Contract Documents
7. Layouts of air distribution systems from construction as-built drawings.
   a. Number all air devices and systems referenced in report body.
   b. Scans of paper drawings are not acceptable. Hand-written notes for numbering devices, duct runs, etc., are permissible, but the basic floor plans and duct / piping layouts, equipment and devices locations, etc., must be from original pdf files.
   c. Indicate duct, outlet, and inlet sizes, pipe and valve sizes and locations, locations of major equipment items such as air handlers, fans, air terminal units, pumps, etc., balancing stations.

8. Summary of Deficiencies:
   a. Report must include a comprehensive summary page listing all equipment / systems which were not balanced to within specified range.
   b. For each instance where system or individual component of a system is not balanced to within specified range, provide a clear explanation of why it cannot be so balanced, and propose remedial steps.
   c. Disclaimers, miscellaneous informational factoids, explanatory text concerning methodology, and other information not specifically relevant to actual deficiencies may be included towards the end of report, but are not to be included on the Summary Of Deficiencies page.

9. Summary Of Critical Measurements and Setpoints:
   a. Provide a table which summarizes critical measurements and settings for all HVAC equipment 1HP and larger. Sample tables provided below for pumps and air-side systems showing minimum required information:

Unit Name	Design CFM	Measured CFM	Design ESP	Measured ESP	Tap or VFD Speed Setting	Req'd Static Stpt
RTU-123	1,000	990	1.50"	1.10"	55%	NA

* Individual system/unit.
a. Nameplate, design, and measured performance as described in this specification.
   1) The intent of TAB measurements is to prove unit performs in accordance with manufacturer's specified and submitted data. Change setpoints as required to achieve this result. (For example in a dedicated outside air unit with hot gas reheat, set the cooling coil leaving air temperature setpoint and the unit leaving air temperature setpoint to achieve cooling coil design.) Clearly indicate in report the setpoints in effect when measurements were taken.
b. Include fan and pump curves for units 1.5HP and larger.
c. For units with VFD speed control: Indicate required VFD speed and whether VFD was speed-limited in its controller settings.

11. Floor plans (as-built) showing HVAC unit locations, duct layouts, air terminal devices numbered to match measured data points.
    a. Show location of air-side pressure sensors, differential or straight pressure, where such sensors are used in control
13. Checklist of DX HVAC unit inspections: **Sample checklists below.** Include comments as required to explain anomalies or deficiencies. (Engineer will provide sample file in Excel format upon request.)

Unit Inspection Checklist

DX Units	**AHU-1**	**AHU-2**	**AHU-2**
Condensate drain pan is clean			
Condensate pan fully draining, no ponding in pan			
No excessive damper air leakage			
No air leakage @ cabinet, doors, duct connections			
Final air filters installed and clean			
Final filters of type/MERV rating specified			
Coil fins undamaged and/or combed straight			
Fan free of vibration, rotating in correct direction			
Unit interior cleaned and vacuumed			
Access doors open fully & freely			

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Water and steam flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Terminal units.
   6. Balancing stations.
   7. Position of balancing devices.

E. RTU/Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
      i. Center-to-center dimensions of sheave and amount of adjustments in inches.
      j. Number, make, and size of belts.
      k. Number, type, and size of filters.

   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Center-to-center dimensions of sheave and amount of adjustments in inches.

   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
      b. Total system static pressure in inches wg.
      c. Fan rpm.
      d. Discharge static pressure in inches wg.
      e. Filter static-pressure differential in inches wg.
      f. Cooling-coil static-pressure differential in inches wg.
      g. Heating-coil static-pressure differential in inches wg.
      h. Outdoor airflow in cfm.
      i. Return airflow in cfm.
      j. Outdoor-air damper position.
      k. Return-air damper position.
      l. Vortex damper position.
      m. Settings for outdoor-, return-air dampers.

         1) Air handling units *may* be designed to operate with fan varying from high to low speed.

2) For such units, TAB must measure required outside air damper (& return, where applicable) position for intake of design ventilation air not only at full fan speed, but at low fan speed as well. Report results in final TAB report.
3) Minimum damper position shall be determined by TAB Contractor such that building remains positively pressurized when building exhaust fans are on. Report results in final TAB report.
4) Convey required damper positions to BAS contractor as soon as they are known, prior to submission of final TAB report.

F. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Compressor make.
   e. Compressor model and serial numbers.
   f. Refrigerant weight in lb.
   g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):
   a. Inlet-duct static pressure in inches wg.
   b. Outlet-duct static pressure in inches wg.
   c. Entering-air, dry-bulb temperature in deg F.
   d. Leaving-air, dry-bulb temperature in deg F.
   e. Control settings.
   f. Unloader set points.
   g. Low-pressure-cutout set point in psig.
   h. High-pressure-cutout set point in psig.
   i. Suction pressure in psig.
   j. Suction temperature in deg F.
   k. Condenser refrigerant pressure in psig.
   l. Condenser refrigerant temperature in deg F.
   m. Oil pressure in psig.
   n. Oil temperature in deg F.
   o. Voltage at each connection.
   p. Amperage for each phase.
   q. Kilowatt input.
   r. Crankcase heater kilowatt.
   s. Number of fans.
   t. Condenser fan rpm.
   u. Condenser fan airflow rate in cfm.
   v. Condenser fan motor make, frame size, rpm, and horsepower.
   w. Condenser fan motor voltage at each connection.
   x. Condenser fan motor amperage for each phase.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.

c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:
a. System and air-handling unit identification.
b. Make, type and model number, size.
c. Number from system diagram.
d. Final k-factor.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.

d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

J. VFD-served equipment:
1. A pump or fan served by a VFD must be balanced for maximum energy efficiency by limiting maximum speed via the VFD ("Maximum Allowed Speed"). It is not acceptable to operate VFD at 60hz (or higher) and then balance system by throttling valves or dampers.
2. VFD Maximum Allowed Speed is to be determined such that design flow is met in the most critical (highest pressure drop) flow path with no throttling in that path. Other flow paths may then be balanced by throttling as needed with VFD at Maximum Allowed Speed.
3. VFD Maximum Allowed Speed shall be programmed at the VFD controller or AHU/RTU.

K. Indoor-Air Quality Measurement Reports for Each HVAC System:
1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, re-visit site to perform additional TAB measurements to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

1. Consult with Engineer prior to site visit to develop a measurement plan, and determine which systems, units, or locations need particular attention.
2. Submit report of findings and modifications made.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.19 SUMMARY OF SYSTEMS SCOPE WORK FOR TESTING AND BALANCING

A. The following systems are to be included in scope of TAB work for this project:

1. Air distribution systems (ducts, dampers, outlets, etc.)
2. Split System DX units, including AHUs.
3. Existing VAV boxes
4. Controls

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 return located in unconditioned space.
3. Indoor, exposed ductwork.

B. Related Sections:
1. Section 230719 "HVAC Piping Insulation."
2. Section 233113 "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. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.5 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 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.

1.6 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 Section 230529 "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.

C. Coordinate installation and testing of heat tracing.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, and are limited to, the following:
   1. Mineral-Fiber Insulation:
      a. CertainTeed
      b. Manson.
      c. Knauf FiberGlass GmbH.
      d. Owens-Corning Fiberglas Corp.
      e. Schuller International, Inc.

2.2 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. 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).
2. Adhesive 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."

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. 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. Adhesive 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 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).

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. 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).
6. Sealants 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."

2.7 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. 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.

2.9 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 4 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.

6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. 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-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless 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.

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-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, 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 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 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.
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 fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping" and fire-resistive joint sealers.

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.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "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 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 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 overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-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 laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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 overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 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.

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. 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.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. 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.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Service: Round & rectangular, supply-air ducts concealed.
1. Material: Mineral-fiber blanket.
2. Thickness: 3 inches (R-8 min).
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

B. Service: Round & rectangular, return, outside-air and fume hood exhaust ducts concealed.
1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches (R-6 min).
3. Number of Layers: One.
4. Field-Applied Jacket: Foil and paper.
5. Vapor Retarder Required: Yes.

C. Service: Round supply, make-up, and outside-air ducts, exposed in conditioned space.

1. Double wall, with 2” insulation thickness, and painted.

D. Service: Return air duct, exposed in conditioned space: No insulation. Paint duct.

E. Service: Ten feet of supply and return air ducts closest to AHU or FCU.
   1. Material: In addition to exterior wrap, provide internal liner for sound attenuation purposes.
   2. Thickness: 1 inches.

F. Service: Ten feet of exhaust air duct closest to where duct penetrates the exterior envelope.
   1. Material: Exterior wrap.
   2. Thickness: 2 inches.

G. Unless noted otherwise, where ductwork is not completely concealed above architectural features such as above acoustical clouds, provide painted wrap insulation. Coordinate color and finish with Architect.

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, indoors.
   2. Refrigerant piping, indoors and outdoors. **Provide insulation on all existing and new refrigerant piping. Provide jacket per specifications.**

B. Related Sections:
   1. Section 230713 "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. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

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 Section 230529 "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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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. Flexible Elastomeric Thermal Insulation:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.2 INSULATION MATERIALS

A. Mineral-fiber insulation will NOT be allowed for use on any cold piping systems.

B. Mineral-fiber wrap is NOT approved for use on piping insulation.

C. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

D. Products shall not contain asbestos, lead, mercury, or mercury compounds.

E. 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.

F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

G. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products:
      a. Aeroflex USA Inc.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
      c. Foster Products Corporation, H. B. Fuller Company; 85-75.
      d. RBX Corporation; Rubatex Contact Adhesive.

   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive 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."

C. 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:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H. B. Fuller Company; 85-20.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive 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 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).

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   3. Service Temperature Range: 0 to plus 180 deg F.
   4. Color: White.

2.6 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.
   4. Color: White or gray.
   5. 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).
   6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.
   5. 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).
   6. Sealants 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."

C. ASJ Flashing Sealants, Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: White.
   5. 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).

6. Sealants 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."

2.7 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.10 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. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      d. 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.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. 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. Width: 3 inches.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless 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. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range. **NO EXCEPTION: PIPES SHALL BE PAINTED.**

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 as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, 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 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 below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "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 Section 078413 "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 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 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

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 overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-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 laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 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 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of fittings, two locations of strainers, three locations of valves, for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

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 PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 3/4 inch thick.
b. Vapor Retarder Required: Yes.
c. Finish: Painted (Coordinate with Architect).

B. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be:
a. Flexible Elastomeric: **1 inch** thick minimum, with two coats of protective coating recommended by the insulation manufacturer.
b. Vapor Retarder Required: Yes.
c. Finish: Painted (Coordinate with Architect).

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.

3.14 OUTDOOR PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be:
a. Flexible Elastomeric: **1 inch** thick minimum, with two coats of protective coating recommended by the insulation manufacturer.
b. Vapor Retarder Required: Yes.
c. Field-Applied Jacket: Aluminum jacket.

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.

1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.020 inch thick.

3.16 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

SECTION 230800 - COMMISSIONING OF HVAC

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 the following MEP systems, assemblies, and equipment:
   1. HVAC equipment.
   2. Controls and instrumentation, including BAS energy monitoring and control system.

B. Related Requirements:
   1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.3 DEFINITIONS

A. Refer to Section 019113 "General Commissioning Requirements" for additional definitions and assignment of responsibilities.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Refer to Section 019113 "General Commissioning Requirements".

B. Perform commissioning tests at the direction of the CxA.

C. Attend construction phase controls coordination meeting.

D. Attend testing, adjusting, and balancing review and coordination meeting.

E. Participate in mechanical systems, assemblies, equipment, and component maintenance orientation and inspection.

F. Provide information requested by the CxA for final commissioning documentation.

G. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for required test period.

H. Provide Project-specific construction checklists and commissioning process test procedures for actual mechanical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

I. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.

J. Verify testing, adjusting, and balancing of Work are complete.

K. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

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

1.6 INFORMATIONAL SUBMITTALS

A. Construction Checklists: See related Sections for technical requirements, and generate construction checklists for the following:
   1. Instrumentation and control for MEP systems.
   2. Split systems, VAV boxes, and related equipment.

B. Certificates of readiness.

C. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Refer to Section 019113 "General Commissioning Requirements".

3.2 SYSTEMS READINESS CHECKLISTS

A. Construction Checklists: Assist CxA in the preparation of detailed Systems Readiness checklists for systems, subsystems, equipment, and components.
   1. Contributors to the development of checklists shall include, but are not limited to:
      a. Systems and equipment installers.

b. TAB technicians.
c. Instrumentation and controls installers.

B. Contractor shall conduct Systems Readiness Testing to document compliance with installation and Systems Readiness checklists prepared by Commissioning Authority for Division-23 items.

C. Refer to Section 019113 "General Commissioning Requirements" for issues relating to Systems Readiness checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.

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 TESTING PREPARATION

A. Certify that 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 approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

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 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.
4. Remedy deficiency and notify CxA so verification of failed portions can be performed.

3.6 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of mechanical testing shall include entire HVAC installation, from equipment 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. 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 System Readiness

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 CX Authority.
3. Functional testing of HVAC systems shall include testing of the BAS.

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 Systems Readiness Checklists have been completed.

3.9 COMMISSIONING TESTS

A. Functional testing will be performed on all HVAC equipment, including but limited to the following:
1. DX Split Systems
2. VAV boxes
3. Building automation system

B. Sample requirements are as follows:
1. Record temperatures, pressures.
2. Record programmed setpoints (unocc/occ temperature, RH, CO2, runtime, safeties, alarms).
3. Record programmed schedules and interlocks.
4. Verify equipment installation
5. Verify equipment operation.
6. Verify electrical voltage and amperages are within tolerance.
7. Verify unit data in TAB report.
8. Verify alarms and safeties.
9. Verify all sequences.
10. Verify setpoint resets, adaptive controls for energy conservation.

C. Customized system readiness checklists and function testing requirements will be released after the submittal review phase.

3.10 TRAINING AND O&M MANUALS

A. Refer to Div. 23 specifications.

END OF SECTION 230800

SECTION 230900 – INSTRUMENTATION AND CONTROLS

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. Design Intent is to replace in its entirety, the outdated BAS (old JCI or old Carrier i-Vu) with new ALC WebCTRL BAS (Base Proposal) or JCI Metasys (Alternate Proposal), that is fully integrated with the equipment, and fully accessible via the web.
   2. BAS shall fully control new and existing equipment, and use BACnet interface on the new equipment to get alarms, alarm codes, and other parameters from the equipment controllers. Coordinate with equipment manufacturer, and integrate controls as needed to ensure that all safeties and warranties are retained.
   3. Provide all new controls, controls architecture, controllers, control points, sensors, end devices, contactors, relays, CTs, wiring, enclosures, engineering, programming, sequences, graphics for a new and fully operational system.
   4. New systems and graphics shall be integrated with the lastest graphics and systems at Idea Public Schools.
   5. Prior to bidding:
      a. Coordinate division of responsibilities with equipment manufacturer such as provision of sensors, equipment startup, proper BACnet integration and troubleshooting.
      b. Visit sites to verify existing systems, locations, conditions, etc.

B. Related Requirements:
   1. For Summary of Work refer to Section 230100.
   2. Section 230993 "Sequence of Operations for HVAC Controls" for control sequences in DDC systems.

1.3 CODE REQUIREMENTS

A. All equipment and material and its installation shall conform to the current requirements of the following authorities, and local amendments:
   1. Occupational Safety and Health Act (OSHA)
   2. International Electric Code (IEC)
   3. International Fire Code
   4. International Building Code
   5. International Mechanical Code
   6. International Plumbing Code
   7. International Energy Conservation Code
   8. UL 916

B. Where two or more codes conflict, the most restrictive shall apply. Nothing in these specifications shall be construed to permit work not conforming to applicable codes.

1.4 ACTION SUBMITTALS

A. All submittals must be in native PDF format, wherein all text is searchable. Submittals which contain scanned documents which are not 'searchable' will be rejected without being reviewed.

B. Product Data: For each type of product include the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
5. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
6. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

C. System Description:
1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. General Requirements:
   a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
   b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.

3. Schematic drawings for each controlled HVAC system indicating the following:
   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
   c. A graphic showing location of control I/O in proper relationship to HVAC system.
   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
   f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
   g. Narrative sequence of operation.

      1) Contractor is expected to review all specified sequences and submit questions concerning any ambiguities, potential errors or omissions, prior to turning in submittals. Submittals which simply restate control sequences as written in specifications are not acceptable. Submittals must include a restatement of sequences as they will actually be programmed.

4. DDC system network riser diagram; indicate each device connected to network with unique identification for each, communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable, network port(s) for connection of an operator workstation or other type of operator interface, etc.
5. Color graphics.
    a. Submit samples and an itemized list of ALL the various graphics pages being proposed for control system. Show layout of pictures, graphics and data displayed, navigation icons, etc.
    b. Graphics for equipment must be schematically correct versus equipment as actually installed (e.g., all sensors, coils, devices, shown in correct locations & sequential order). In all cases, the graphics must be cross-checked with the engineering drawings.
    c. Engineer's approval of submitted sample graphics pages represents preliminary approval and does not preclude the possibility that graphics' deficiencies may be found in subsequent testing and inspections.

D. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. 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.

1.5 INFORMATIONAL SUBMITTALS

A. All submittals must be in native PDF format, wherein all text is searchable. Submittals which contain scanned documents which are not 'searchable' will be rejected without being reviewed.

B. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

C. Systems Provider Qualification Data: Resume of project manager, installation and programming technician, and service technicians assigned to Project, including name, phone number, and e-mail address.

D. Product Certificates: Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

1.6 CLOSEOUT SUBMITTALS

A. As-built record documentation per section 017700 – Closeout Procedures.

B. Operation and Maintenance Data: For DDC system to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
      b. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
      c. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
      d. Engineering, installation, and maintenance manuals.
      e. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
      f. Backup copy of graphic files, programs, and database in electronic media form.
      g. List of recommended spare parts with part numbers and suppliers.
      h. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
      i. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
      j. Licenses, guarantees, and warranty documents.
      k. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
      l. Owner training materials and evidence of the training provided to the owner’s staff.
      m. For all BACnet-connected devices, on a separate dedicated page, document only selected points readable BACnet points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Include product manufacturers' recommended parts lists for proper product operation over five-year period following warranty period. Parts list shall be indicated for each year.

1.8 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical circuits for control units.

C. Coordinate equipment with Division 16 Section "Panelboards".

1.9 PAYMENTS

A. 10% of controls cost will be withheld until documentation is provided that the Commissioning and Acceptance Test was carried out, and that it was verified by Engineer.

B. 5% of controls cost will be withheld until documentation is provided that the Training was carried out, and that it was acceptable by the Owner.

1.10 CONTRACTOR RESPONSIBILITY

A. All control items, services, and work shown in specifications and drawings shall be provided by Controls Contractor either directly or by subcontract. These shall include, but are not necessarily limited to, the following:
   1. Install control equipment incorporating DDC for energy management, equipment monitoring and control, software, programming, including color graphic workstations.
   2. Provide control relays and devices, air flow monitoring devices, pressure and temperature sensing devices, valves, dampers and actuators (unless noted elsewhere in construction documents that they are to be provided by others), etc.
   3. Provide electrical work associated with control system and as called for on Drawings. Perform all wiring in accordance with all local and national codes. Provide all line voltage wiring, concealed or exposed, in accordance with Div. 26. All low voltage electrical control wiring throughout the building when exposed shall be run in conduit in accordance with Division 26. All low voltage wiring run in concealed accessible areas shall be run using plenum rated wire only.
   4. Provide 120V power for direct digital control systems PCU's, and LCU's, as defined later in these specifications, and make final panel hook-up and all final electrical connections to each controller. Provide power for all valve, and damper-actuators including VAV boxes.
      a. Power circuit to PCU/LCU shall serve PCU/LCU and no other equipment.
      b. Use spares or provide new circuit breaker.
   5. Use spare circuit breakers or provide new where no spares exist.
   6. Provide all wiring and conduit for all DDC temperature controls, monitoring devices including DDC signal wiring.
   7. Provide all control relays. Where motor starters are not called for or do not exist for 1-phase equipment, provide relays and contactors as required for start/stop control by BAS.
   8. Provide surge transient protection shall be incorporated in design of system to protect electrical components in all primary control units.
   9. Provide all warranty related work, products, materials, and labor.
   10. Provide all software programming.
   11. Provide consulting and programming services to Owner and Installing Contractor as required to resolve operating problems after system installation.
   12. Provide shop drawings indicating equipment locations, points allocation, and schematic wiring. Submittals shall indicate all information pertinent to PCU locations, PCU capacity and spare points, input/output module configuration within PCUs, communication trunks, sensors, valves, pneumatic interface, wiring, and other pertinent equipment information requiring approval prior to field installation. Provide a DDC system riser diagram showing buildings, controller or device within each building, and listing equipment controlled or monitored by each.

13. Provide graphics programming, showing floor plans of all buildings, equipment locations, and operating parameters.
14. Provide self-commissioning of system.
15. Provide reference manuals.
16. Provide Owner training.
17. Warranty work.
18. Other services, materials, and products as called for in construction documents.

B. The following equipment and services shall be coordinated with the Owner:
1. A network connection made available for BAS, at a location designated by the Owner.

C. Coordinate with Mechanical Contractor. Mechanical Contractor provides:
1. Installation of control valves, control dampers, actuators and all manual dampers.
2. Temporary 24V thermostat for new equipment, if required.
3. Fan coil units with factory-installed dampers (where indicated).
4. Rooftop / AH units with factory-installed outside air damper actuator and controls.

1.11 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:
1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of ten years within time of bid.
3. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
4. Having full-time in-house employees for the following:
   a. Product research and development.
   b. Product and application engineering.
   c. Product manufacturing, testing and quality control.
   d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
   e. Owner operator training.

B. DDC System Provider / Installer Qualifications:
1. A direct factory owned office of the manufacturer, for the brand or make of control equipment to be supplied, with engineers capable of providing instructions, routine maintenance, design services, programming, and emergency system service on staff.
2. Project supervisor and programmers shall be DDC system manufacturer employees. Only construction services not directly related to DDC system operation (such as provision of electrical power, conduit installation and wire-pulling, etc.) may be subcontracted to non-manufacturer workers.
3. A manufacturer’s employee working on this project shall be officed within 40 miles of Project and assigned to support Project during warranty period.
4. Each manufacturer employee assigned to Project shall be a competent and experienced full-time employee with demonstrated past experience on at least 5 projects of similar complexity, scope and value.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
   a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence no later than 8 hours following Owner's warranty service request.
4. Warranty Period: **Two years from date of final system acceptance**.

   a. Final Acceptance of system is not related to nor dependent upon Substantial Completion. **Final system acceptance will be granted only after system is operating without any substantive problems for a minimum of 30 consecutive days, and all issues on Commissioning Issues Log and Engineer's punch lists have been resolved.**

   b. Obtain formal written approval from Engineer and Owner contractual date of system Final Acceptance. Determination of final system acceptance date is at Engineer's discretion, in coordination with input from commissioning agent

B. Warranty Inspections
   1. At approximately 12 months and 24 months after Final Acceptance of control system, provide a minimum 5 hour on-site inspection of system.
   2. Inspection will include an evaluation of performance of the system, including an accuracy of all sensors (re-calibration or replacement is required for sensors obviously inaccurate), solicitation of operator's input of system problems and inadequacies, review of operating sequences and alarm logs to discover potential recurring problems or nuisances, discovery of any failed points, and general system reliability.
   3. **Provide a written report of each site visit summarizing activities and findings, and recommendations for improving system performance.**
   4. **Failure to provide the on-site inspections at a time near that specified, or by the end of Warranty, regardless of whether specifically requested by owner, does not relieve contractor of obligation to provide such inspections.** Within a period of 5 years after system Final Acceptance, should owner request contractor provide a system inspection that *was not provided* within the 24 months period after Final Acceptance, contractor will provide such inspection in compliance with subparagraphs 2 and 3 above. Any and all control system deficiencies found are to be remedied as warranty items.

1.13 EXTRA MATERIALS

A. Furnish quantity indicated of matching product(s) in Project inventory **for each unique size and type** of following:
   1. Room Relative Humidity Sensor and Transmitter: Five.
   2. Adjustable Range Room Temperature Sensors: Five.
   3. CO2 sensor: Five.
   4. Current-Sensing Relay: Five.

1.14 EQUIPMENT AND SOFTWARE UPDATES / UPGRADES / REVISIONS

A. Equipment: All equipment, components, parts, materials, etc. provided shall be fully compatible with all other equipment provided at any other time throughout the warranty period. Should updated versions be provided that are not fully compatible with earlier equipment

provided (e.g.: a requirement to add hardware or software "interfacing" between an earlier and later generation results in the system not being fully compatible), Controls contractor shall replace earlier equipment with the later version at no cost to Owner.

B. Software: If acceptable to the Owner, all software upgrades applicable to the system and offered by the manufacturer / contractor for this system shall be provided at no cost to the Owner throughout the warranty period. This no cost upgrade shall include installation, programming, modification to field equipment, data base revisions, etc. all as appropriate.

C. Revisions: Hardware / software revisions made related to refining sequences of control, adding/monitoring control points, or other similar operations shall be made with all "burn-in" performed at the contractor's expense, throughout the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Following Manufacturer's are allowed to bid on this project:
1. ALC WebCTRL (Base Proposal)
2. JCI Metasys (Alternate Proposal)

2.2 DDC SYSTEM DESCRIPTION

A. Modular, microprocessor-based, high-speed, peer-to-peer network of distributed DDC controllers, operator interfaces, and software monitoring and control, including analog/digital conversion and program logic, utilizing stand-alone controllers operating over a local area network allowing peer-to-peer communication among all system controllers, and communications interface to Owner's Central Operator's Station.

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.

2.3 WEB ACCESS

A. DDC system shall be Web based.
1. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet.
2. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
3. Web-Compatible Access to DDC System:
   a. Operator workstation and server shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.
   b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.
   c. Web access shall be password protected

2.4 PERFORMANCE REQUIREMENTS

A. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

B. System Response Time:
   1. Graphic display refresh shall update within eight seconds.
   2. AI point value shall update within 5 seconds, BI point values within 10 seconds.
   3. AO and BO points shall begin to respond to controller output commands within three second(s).
   4. Alarms of analog and digital points connected to DDC system shall be displayed within 15 seconds of activation or change of state.
   5. Global commands shall also comply with this requirement.

C. Future Expandability:
   1. DDC system size shall be expandable to an ultimate capacity of at least four times total I/O points indicated.
   2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
   3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

D. Environmental Conditions for Controllers, Gateways, and Routers:
   1. Products, instruments, and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
      a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

   2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:
      a. Outdoors, Protected: Type 3.
      b. Outdoors, Unprotected: Type 4X.
      c. Indoors, Heated with Ventilation: Type 2.
      d. Indoors, Heated and Air Conditioned: Type 1.
      e. Unconditioned Chiller and Boiler Rooms: Type 4X.
      f. Conditioned Mechanical Equipment Rooms: Type 1.
      g. Air-Moving Equipment Rooms: Type 1.
      h. Localized Areas Exposed to Washdown: Type 4X.

E. Electric Power Quality:
      a. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41. Do not use fuses for surge protection.

2. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.
3. Power Conditioning:
   a. Protect DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
   b. At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
   c. During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
   d. Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
   e. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

F. UPS: Provide UPS power protection for Servers, and DDC controllers (except application-specific controllers), and Gateways.

G. Continuity of Operation after Electric Power Interruption: Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.5 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES

A. Manual Override of Control Dampers:
1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller. Label each switch with damper designation served by switch, and switch positions to indicate either "Manual" or "Auto" control signal to damper. With switch in "Auto" position signal to control damper actuator shall be control loop output signal from DDC controller.
   a. For Binary Control Dampers: Manual two-position switch shall have "Close" and "Open" switch positions indicated. With switch in "Close" position, damper shall close. With switch in "Open" position, damper shall open.
   b. For Analog Control Dampers: A gradual switch shall have "Close" and "Open" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.

2. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.

2.6 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than two levels of LANs.
1. Level one LAN shall connect network controllers and operator workstations.
2. Level two LAN shall connect application-specific controllers to application-specific controllers.

B. Minimum Data Transfer and Communication Speed:
1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
2. LAN Connecting Programmable Application Controllers: 1000 kbps.

3. LAN Connecting Application-Specific Controllers: 19,200 bps.

C. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.

D. System architecture shall be modular and have inherent ability to expand to not less than three times system size indicated with no impact to performance indicated.

E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

G. Special Network Architecture Requirements:
1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s).

2.7 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:
1. Desktop and portable operator workstation with hardwired connection through LAN port.
2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. PDA with wireless connection through LAN router.
5. Remote connection using outside-of-system computer or PDA through Web access.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Network Ports: For hardwired connection of desktop or portable operator workstation. Network port shall be easily accessible, properly protected, and clearly labeled.

D. Desktop and Portable Workstations:
1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Able to communicate remotely with any device connected to any DDC system LAN.
4. Connect to DDC system sub-LANs through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
5. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.

E. Personal Digital Assistant:
1. Connect to system through a wireless router connected to LAN.
2. Able to communicate with any DDC controller connected to DDC system.

F. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention. System shall send alarm notification to multiple recipients that are assigned for each alarm.
2. Alarms must be set to observe proper time delays and other logic to avoid nuisance tripping.
3. **Coordinate with Owner's representatives to set up Owner's desired alarm notification procedures and methodologies by means including e-mail, text message and pre-recorded phone message to mobile and landline phone numbers.**
4. Any alarm that registers and appears in alarm history or event viewer history must have clear description of what the alarm is and the name equipment.
5. Any alarm that is created by a BACnet signal from controlled/monitored equipment must be read and displayed in alarm history by BAS.
6. Email and text alarm notifications must be sent to designated owner's representatives for any alarm deemed critical by owner or these specifications.
7. Alarms registering must be configured to avoid nuisance and irrelevant alarms, and to avoid repetitive alarm registering with high frequency.

G. Simultaneous Operator Use: Capable of accommodating simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.8 NETWORK COMMUNICATION PROTCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to public and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:
1. ASHRAE 135 communication protocol shall be a required protocol used throughout entire DDC system. The Web Server shall support the BACnet Interoperable Building Blocks (BIBBS) for Read (Initiate) and Write (Execute) Services.
2. System shall not require use of gateways except to integrate HVAC equipment and other systems and equipment not required to use ASHRAE 135 communication protocol.
   a. Review manufacturer's communications protocols for all systems with which BAS will integrate, and provide gateways as required to allow full communication, such as, for examples, Modbus Application Protocol Specification V1.1b, LonWorks technology using CEA-709.1-C.

2.9 DESKTOP OPERATOR WORKSTATIONS

A. Not Applicable. Use Owner's existing.

2.10 PORTABLE OPERATOR WORKSTATIONS

A. Not Applicable. Use Owner's existing.

2.11 PRINTERS

A. Not Applicable. Use Owner's existing.

2.12 SERVERS

A. Furnish a Web Server to allow daily operations functions, using real-time system data, to be accomplished from any network connected web browser, from within the facility or in remote locations throughout the world.

B. Servers shall include software license(s), and CAT-5e or CAT-6 cable installation between server(s) and network.

C. Operator Interface: The web server shall reside on a high-speed network with the building controllers. Web pages generated by this server shall be compatible with the latest versions of Microsoft Edge, Google Chrome, Mozilla Firefox, and Apple Safari browsers. Any of these supported browsers connected to the server shall be able to access all system information. Mobile devices shall be recognized by the web server and shall supply the appropriate system content as needed. The Operator Interface (web server with client devices) shall conform to the BACnet Operator Workstation (B-OWS) or BACnet Advanced Workstation (B-AWS) device profile as specified in ASHRAE/ANSI 135 BACnet Annex L. This includes the ability to configure and/or reconfigure the system from the client device (change programs, graphics, labels, etc.). No additional software shall have to be installed on the client PC for normal operation of the system.

D. Communication: Web server and controllers shall communicate using the BACnet protocol. Web server and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135, BACnet Annex J. Communication between the web server and client (workstation) shall be HTTP or HTTPS protocol utilizing HTML5 language. Use of Adobe Flash in any part of the communication infrastructure is not acceptable.

E. Web server shall be able to be located on the Owner's Intranet or on the Internet.

F. Web server shall have the ability to automatically obtain an IP (Internet Protocol) address using DHCP. Use of static IP addressing shall also be supported.

G. Web server will have adequate capacity to store and serve 500 user defined graphics, and to archive not less than 12 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.

H. Functionality:
1. A minimum of 30 users shall be able to utilize the system device at the same time. Operators with proper security shall be able to:
   a. View graphical information about a facility, change setpoints, perform overrides.
   b. View and change schedules.
   c. View and acknowledge alarms.
   d. View historical information.

2. Operators must enter in a valid unique user name and password to access the system.
3. Operator security: The Web server shall include industry standard security protocols to prohibit access by unauthorized users over the World Wide Web. Provide firewalls between server Web and networks with password protection for access to server from Web server.
4. The web server shall display the same graphics that have been created for the Operators Workstation.
5. Operators with proper access shall be able to configure the web server using their web browser.

I. Web Server Hardware.
1. Web server and/or workstation: Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times

specified elsewhere in this document. The web server may also be configured in client/server fashion to accommodate a "workstation" definition. In "workstation" configuration, the workstation will also perform as a server supplying additional clients as needed. The following hardware requirements apply:

a. System storage shall have sufficient memory to accommodate:
   1) All required system software.
   2) A DDC database to accommodate, as a minimum, twice the size of the delivered system database.
   3) Two years of archival trend data based on the points specified to be trended at their specified trend intervals.

b. Provide additional hardware (communication ports, video drivers, network interface cards, cabling, etc.) to facilitate all control functions and software requirements specified for the DDC system.

c. Minimum hardware configuration shall include the following:
   1) Quad Core Processor
   2) 4-24 GB RAM (size dependent on size of system)
   3) 500 GB hard disk providing data at 3.0 Gb/sec (size dependent on historical data storage requirements)
   4) Qwerty Keyboard
   5) Optical Mouse
   6) 24-inch LED Color monitor with 75Hz refresh rate and 1080P resolution to provide a minimum screen resolution of 1920 x 1080 pixels.
   7) Serial (USB) and network communication ports, with cables as required for proper DDC system operation.

2.13 SYSTEM SOFTWARE

A. Operating System: Web server shall have an industry-standard professional-grade operating system. Operating system shall meet or exceed the BMS manufacturer's minimum requirements to support their software. Acceptable systems include Microsoft Windows 11, Windows Server 2016, 2019, 2020[RD1.1], 2025, Red Hat Enterprise Linux 7.4, or Ubuntu Desktop 22.04 LTS, 24.04 LTS.

B. Security: The web server application shall support Transport Layer Security (TLS) 1.3 capable of encryption of up to 256 bit elliptical curve for transmitting private information over the Internet using HTTPS. Additionally, the web server shall have SHA-2 certificate support capability.

C. Database: System shall support any JDBC (Java DataBase Connectivity) compliant engine. This includes: MS SQL, My SQL, Apache Derby, PostgreSQL and Oracle.

D. The BMS system shall allow an unlimited number of concurrent users.

E. The BMS manufacturer shall provide all software and tools necessary to provide the following capabilities:
   1. Create and/or edit any programming used in controllers
   2. Create and/or edit any graphics used in the system
   3. Software shall not be subscription based and be given to owner at time of turnover. If software is subscription based, manufacturer shall include 10 years of subscription service.
   4. The owner shall have the ability to install software on a minimum of five (5) additional owner furnished computers without additional licenses or fees.

F. System Software Minimum Requirements:
1. Provide all software required for efficient operation of all the automatic system functions required by this specification. Software shall be modular in design for flexibility in expansion or revision of the system. It is the intent of this specification to require provisions of a system which can be fully utilized by individuals with no, or limited, previous exposure to PC's and programming techniques and languages.
2. The software in the system shall consist of both "firmware" resident in the PCU's and "software" resident in the operator work stations. The architecture of the system, and the application software/firmware shall be distributed with no single system component responsible for a control function for the entire Controller LAN. Each PCU shall contain the necessary firmware and I/O capability to function independently in case of a network failure. No active energy management or environmental control sequences shall be resident in the PC work stations. All PC work stations shall be removable from the system without loss of control function - only alarm monitoring, long term history collection, and operator monitor/command/edit functions would be lost.
3. Software: **All software upgrades applicable to the system and offered by the manufacturer / contractor for this system shall be provided at no cost to the Owner throughout the warranty period.** This no-cost upgrade shall include installation, programming, modification to field equipment, data base revisions, etc. all as appropriate.
4. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
5. Operating system shall be capable of operating DOS and Microsoft Windows applications.
6. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
7. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
8. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
9. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

G. Basic Interface Description
1. Operator workstation interface software shall minimize operator training through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality: a. Graphical viewing and control of environment
2. Scheduling and override of building operations
3. Collection and analysis of historical data
4. Definition and construction of dynamic color graphic displays
5. Editing, programming, storage and downloading of controller databases
6. Provide a graphical user interface which shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.
    a. Provide functionality such that all operations can also be performed using the keyboard as a backup interface device.

b. Provide additional capability that allows at least 10 special function keys to perform often used operations.

7. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The mouse shall be used to quickly select and switch between multiple applications. This shall be accomplished through the use of Microsoft Windows or similar industry standard software that supports concurrent viewing and controlling of systems operations. a. Provide functionality such that any of the following may be performed simultaneously, and in any combination, via user-sized windows:
   a. Dynamic color graphics and graphic control
   b. Alarm management coordinated with section 2.04.E.
   c. Time-of-day scheduling
   d. Trend data definition and presentation
   e. Graphic definition
   f. Graphic construction

8. If the software is unable to display several different types of displays at the same time, the EMS contractor shall provide at least two operator workstations.
9. Multiple-level password access protection (minimum of five levels of access) shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
   a. Level 1 = View all applications, but perform no database modifications
   b. Level 2 = Custodial privileges plus the ability to acknowledge alarms
   c. Level 3 = All privileges except system configuration
   d. Level 4 = All configuration privileges except passwords
   e. Level 5 = All privileges

10. A minimum of 50 unique passwords, including user initials, shall be supported.
11. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed shall be limited to only those items defined for the access level of the password used to log-on.
    a. The system shall automatically generate a report of log-on/log-off time and system activity for each user.
    b. User-definable, automatic log-off timers of from 5 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.

12. Software shall allow the operator to perform commands including, but not limited to, the following:
    a. Start-up or shutdown selected equipment
    b. Adjust setpoints
    c. Add/modify/delete time programming
    d. Enable/disable process execution
    e. Lock/unlock alarm reporting for points
    f. Enable/disable totalization for points
    g. Enable/disable trending for points
    h. Override PID loop setpoints
    i. Enter temporary override schedules
    j. Define holiday schedules
    k. Change time/date
    l. Automatic daylight savings time adjustments
    m. Enter/modify analog alarm limits
    n. Enter/modify analog warning limits

o. View limits
p. Enable/disable demand limiting for each meter
q. Enable/disable duty cycle for each load

H. Reports and Logs:
1. Reports shall be generated and directed to either CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:
a. A general listing of all points in the network
b. List of all points currently in alarm
c. List of all points currently in override status
d. List of all disabled points
e. List of all points currently locked out
f. DDC Controller trend overflow warning
g. List all weekly schedules
h. List of holiday programming
i. List of limits and deadbands.
j. Summaries shall be provided for specific points, for a logical point group, for a user-selected group or groups or for the entire facility without restriction due to the hardware configuration of the building automation system. Under no conditions shall the operator need to specify the address of the hardware controller to obtain system information.

2. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
3. Each report shall be definable as to data content, format, interval and date.
4. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on server for historical reporting.
5. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
6. Reports and logs shall be stored on [workstation] [and] [server] hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
7. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

I. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.
1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Alarm history.

J. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report.

K. Scheduling:
1. Monthly calendars for a 24-month period shall be provided which allow for simplified scheduling of holidays and special days in advance.
2. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule.

3. Zone schedules shall be provided for each building zone. Each commandable point may have a unique schedule of operation relative to the zone' s occupancy schedule, allowing for sequential starting and control of equipment within the zone.
4. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation.
5. Collection and Analysis of Historical Data
    a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user definable. Trend data may be stored on hard disk for future diagnostics and reporting.
    b. Trend data report graphics shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or pre-defined groups of at least 6 points. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Lotus 1-2-3a. This shall allow the user to perform custom calculations such as energy usage, equipment efficiency and energy costs and shall allow for generation of these reports on high-quality plots, graphs and charts.

2.14 GRAPHICS

A. Provide Central Operator's Station with software and hardware as needed to meet requirements specified herein. Graphics are to be online programmable and under password control.

B. System shall be provided with complete color graphics software package, such that graphics can be created by user from time of software installation, without need for additional hardware or software. Each operator work station shall support not less than 1,000 separate graphic pages. Contractor shall include developed graphics as approved by the Owner's representative for this project.

C. Graphics program shall be fully user interactive, full color, incorporating the following capabilities:
1. Up to 50 dynamic points of data per graphic page
2. Animated objects for discrete points to illustrate point status
3. On-line 'draw' utility
4. Ability to import .PCX or .DXF file format graphics developed in third party programs
5. "Page Linking" such that it is possible to "zoom" into a specific AHU or any other page through a sequence of graphics without using anything but the system mouse.
6. Generate, store, and retrieve library symbols for use in generating graphic pages.
7. Fifty (50) dynamic points of data per graphic page.
8. Pixel level resolution. Graphics will be displayed on EGA monitors with a 640 X 350 resolution, and on VGA monitors with a 640 X 480 resolution, minimum. Color selections will be made from a color bar consisting of 16 colors, with adjacent text description.
9. Animated objects for discrete points (i.e., when a pump starts, the pipe fills with water or when a damper shuts it goes closed on the screen).
10. Analog bar graphs for analog points. The operator shall be able to locate up to 60 bar graphs per graphic page, with options as to bar graph color, dimensions, horizontal/vertical orientation, and limit values.

D. Provide for import of .PCX file format graphics developed in third party programs such as Paintbrush. Such imported graphics shall be used as a "backdrop", so that all other dynamic and animated system features may be superimposed on this graphic. Similarly, it shall be possible to

import CAD type drawings, by first converting the CAD drawing from .DXF format to .PCX format.

E. The EMS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g., fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g., constant volume-terminal reheat, VAV, etc.) and electrical symbols, so that Owner may develop graphics.

F. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:

1. Define symbols
2. Position and size symbols
3. Define background screens
4. Define connecting lines and curves
5. Locate, orient and size descriptive text
6. Define and display colors for all elements
7. Establish correlation between symbols or text and associated system points or other displays

G. System shall allow graphical displays to be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DCU Controllers including Terminal Equipment Controllers used or DDC equipment.

H. System Configuration and Definition
1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
2. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:
   a. Add/delete/modify stand-alone DDC Controller panels
   b. Add/delete/modify operator workstations
   c. Add/delete/modify application specific controllers
   d. Add/delete/modify points of any type and all associated point parameters and tuning constants
   e. Add/delete/modify alarm reporting definition for points
   f. Add/delete/modify control loops
   g. Add/delete/modify energy management applications
   h. Add/delete/modify time and calendar-based programming
   i. Add/delete/modify totalization for points
   j. Add/delete/modify historical data trending for points
   k. Add/delete/modify custom control processes
   l. Add/delete/modify any and all graphic displays, symbols and cross-reference to point data
   m. Add/delete/modify dial-up telecommunication definition
   n. Add/delete/modify all operator passwords. Add/delete/modify alarm messages

3. Definition of operator device characteristics, DCU Controllers individual points, applications and control sequences shall be performed using instructive prompting software. a. Libraries of standard application modules such as temperature, humidity and static pressure control may be used as "building blocks" in defining or creating new

control sequences. In addition, the user shall have the capability to easily create and archive new modules and control sequences as desired via a word processing type format. Provide a library of standard forms to facilitate definition of point characteristics. Forms shall be self prompting and incorporate a fill-in-the-blank approach for definition of all parameters. The system shall immediately detect an improper entry and automatically display an error message explaining the nature of the mistake.

4. Inputs and outputs for any process shall not be restricted to a single DCU Controller, but shall be able to include data from any and all other network panels to allow the development of network-wide control strategies. Processes shall also allow the operator to use the results of one process as the input to any number of other processes (cascading).
5. Provide the capability to backup and store all system databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DCU Controller. Similarly, changes made at the DCU Controllers shall be automatically uploaded to the workstation, ensuring system continuity. The user shall also have the option to selectively download changes as desired.
6. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

I. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways, and other network devices.
2. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.
3. Alarms display shall include the following:
   a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
   b. **"Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."**
   c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
   d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

4. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.
5. Send e-mail, page, text and voice messages to designated operators for critical alarms.
6. Alarms shall be categorized and processed by class.
   a. Class 1:

      1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
      2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
      3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.

   b. Class 2:

1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
2) Acknowledgement may be through a multiple alarm acknowledgment.

c. Class 3:

1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.

d. Class 4:

1) Routine maintenance or other types of warning alarms.
2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

7. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
8. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

J. Trends:
1. Trend all I/O point present values, set points, and other parameters indicated for trending.
2. Trends shall be associated into groups, and a trend report shall be set up for each group.
3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75% of DDC controller buffer limit, or by operator request, or by archiving time schedule.
4. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Set trend intervals for each I/O point after review with Owner and CxA.
5. When drive storage memory is full, most recent data shall overwrite oldest data.
6. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

2.15 GRAPHICS PAGES LAYOUT AND QUALITY

A. All proposed graphics pages are to be submitted to engineer for approval prior to uploading to system.
1. After uploading graphics pages to system, cooperate with Engineer and Owner to fine tune graphics pages with respect to layout, formatting, points displayed, etc.

B. Schematic representation of all equipment and system graphics must be accurate and representative of the actual installed field conditions, such as respective locations of indicated devices, air flow patterns, etc. Changes in the field installation, variances in equipment installed versus equipment specified, etc., will require controls subcontractor to revise graphics.

C. Control and monitored points for any system may be presented ***solely*** in tabular form, without graphic representation, only with prior approval of Engineer. Otherwise, a graphical page showing system schematic must be provided for each system.

D. Where Modbus or Bacnet interface with equipment controllers is provided, all readable / writeable points available must be accessible via BAS. Of these total number of points, a limited, select number of critical points must be displayed on a dedicated graphics page, accessible by clicking on the schematic of the equipment/system with which associated.
   1. Provide Engineer with latest updated list of Bacnet or Modbus points, names and addresses from equipment manufacturer.
      a. Where selected Bacnet points to display are not designated in drawings or these specifications, budget for displaying up to 30 such points to be selected by Engineer and/or Owner from the latest updated list of Bacnet or Modbus points for equipment being monitored.

   2. Equipment manufacturer's point names are often unclear or ambiguous as to what they actually reference. Contractor will modify any point text descriptor per Engineer and/or Owner direction so than the meaning is absolutely clear.

E. Building floor plans
   1. Building floor plans are to indicate clearly separate HVAC zones. Distinction between HVAC zones may be illustrated by a variety of means acceptable to Engineer, including darker lines surrounding the zone, color variations, superimposed duct layouts, etc. A clear indication of the extent of floor plan served by each unit must be given. Depending upon temperature-dependent color-coding
   2. Engineer endeavors to provide current floor layouts in contract drawings. However, Owner may modify buildings by adding doors or walls, etc. If necessary due to changes in building floor plans, revise graphics to show accurate wall and door locations.
   3. All building floor plans must indicate final room numbers (exceptions to include only very small rooms which have no thermostat, such as janitor's closets, etc.). Prior to producing floor plan graphics, confirm in writing from Owner and/or Architect what final room numbers are. Graphics display for special purpose rooms, such as Gyms, Cafeterias, Band Halls, etc., must show this generic name of room in addition to room number (if it is indicated on drawings).
   4. Locations of all major equipment (VAV boxes, air handlers, exhaust fans, chillers, boilers, pumps, etc.) are to be indicated on floor plans, along with a clear indication of the area each serves.
   5. Floor plan graphic of each zone is to be color-coded, displaying different colors to show space conditions are within or out of specified temperature range.
   6. All temperature, relative humidity, and CO2 sensors locations are to be indicated on floor plans in actual position where installed. A clear indication of which unit(s) is controlled by that sensor must be given (such as by a dashed or curved line connecting the two).
   7. Actual readings of temperature, relative humidity, and CO2 sensors are to be indicated on floor plans. Readings must be strategically placed on graphic screen so that there is no ambiguity whatsoever as to which room(s) the values apply (without having to hover over or click on the values). Where this proves not to be possible given graphical constraints, provide an acceptable method of clarification, such as a line connecting the room sensor symbols to the values.

F. Graphics text
   1. All text displayed on graphic must be large enough to be clearly and easily readable. Font colors must be chosen for good contrast against background so that they are clearly

and easily readable. Super-position of separate text lines overlapping one another overlapping other iconography, or truncated text is not acceptable.

2. Text wording for labeled points must be clear and easily understood to any person with moderate experience with HVAC systems.
3. Not all text must have identical font and style on each individual graphic page. Use of varying size and style is required and helpful in identifying and distinguishing important values. However, use consistent font size and style for displaying parameters of similar nature or importance.
4. Text for all parameters must be so positioned on graphics screens that it is unquestionably obvious to what symbols, equipment, or values it applies. This is typically done by placing the text very close to the item to which it applies. Where graphics prevent this (e.g. where it would be too crowded and therefore unclear), use arrows or lines connecting value to the item.
5. Equipment indicated in graphics must be identified with the precise name as indicated in drawings in order to facilitate cross-referencing between graphics and drawings. Where equipment name has changed or Owner desires it be changed, make such modification on final graphics pages.
6. Symbols for devices such as smoke detectors, cut-out safety switches, filter dP sensors, heating or cooling coils, etc., must be labeled so that it is unambiguously clear what the symbol represents.
7. Spelling on graphics pages must be correct.

G. Specified Points

1. *At a minimum*, every input and output listed as a point in bid documents must be displayed graphically.

H. Units

1. Units for all parameters are to be listed on graphics screens or other screens. Use the following nomenclature, or other only as approved by Engineer.
   a. Commanded state: On/Off or Off/Enable, as appropriate
   b. Variable speed motor (e.g. fan or pump) commanded speed: % of full speed

      1) It is unacceptable to display BAS output signal to VFD when such signal does not correspond to the actual VFD/fan speed. Coordinate closely with VFD programming such that speed indication on BAS screen exactly matches actual VFD speed. When VFD is off, speed displayed on graphic must show 0%.

   c. Variable speed motor (e.g. fan or pump) speed feedback: % of full speed feedback
   d. Duct static pressure and duct static pressure setpoint: in. WC, or "wc, following by ‘setpoint’ when value displayed is the setpoint
   e. Temperature: ˚F, or deg F, or simply ‘F’

      1) Outside air temperature: OAT
      2) Discharge or supply air temperature: use either DAT or SAT
      3) Return air temperature: RAT

   f. Relative humidity: % RH
   g. Valve or damper analog output commanded position: % open

      1) For cooling tower bypass valves, add descriptive text such as “% open to bypass”)

h. Valve or damper analog output feed back position: % open / position feedback
i. CO2 reading and CO2 setpoint: ppm
j. Hydronic system pressure: psi
k. Hydronic system differential pressure: psi dP, or psi ΔP
l. Chiller cooling load: Tons
m. Refrigerant system pressure: psi
n. Alarm state of any point: Alarm / Normal
o. Air flow: CFM
p. Water flow: GPM
q. Light level: fc (footcandles)
r. Filter status: Dirty / Clean for digital, in. WC, or "wc for analog
s. Power and energy: kWh, kW, KVA.
t. Power factor: PF

2. For any additional parameters not specifically listed above, use similarly descriptive, standardly accepted units designations, approved by Engineer.
3. Consistent nomenclature for points must be used throughout all graphics pages.
4. Graphics text MUST distinguish between On/Off and Off/Enable digital output points. Typical Off/Enable items include chillers, boilers, DX units, etc. Typical On/Off items include fan motors, pumps, etc. Do not indicate a status or command value of "ON" for equipment that is actually controlled as Off/Enable.
5. **Numerical values for all units are to be displayed to decimal point values truncated to a level commensurate with the accuracy of the sensor.** Unless otherwise noted, display values to the following decimal accuracy:
   a. List to 0 decimal points accuracy: Variable speed drive speed, relative humidity, % valve and damper position, CO2 concentration, water flow, air flow, gallons, kWh, KVA, kW, amps.
   b. List to 1 decimal point accuracy: Temperature sensor inputs, temperature setpoints, duct static pressure, and voltage.
   c. List to 2 decimal point accuracy: Building static pressure, Power Factor.

I. Reset schedules
   1. ALL reset schedules specified in operating sequences must be clearly indicated on the screen of the equipment to which it applies. (For example, a chilled water supply temperature reset schedule versus outside air temperature must be listed on the chiller graphic page.) All values in this reset schedule are to be operator adjustable by clicking on the value within the reset schedule.

J. Forced parameters
   1. Provide a clear indication on graphic screen when automatic control or readout of *any* point (command or status, input or output, analog or digital) has been overridden (usually referred to as being placed in Operator or Forced or Manual mode). This may be done in a variety of ways acceptable to engineer (such as placing a large, bold M next to the point, having the point value flash red, placing a dashed rectangle around it, etc.)
   2. The indication of a point being in Forced mode must be placed on the main graphic screen of the equipment such that Operator is not required to access other backup screens to see which points are Forced.

K. Provide navigation icons or "linkages" for major systems pages or major equipment items to allow the operator to switch quickly from one major system or building area screen to another.

L. Indication of equipment Status

1. Graphics must make clear with no ambiguity the meaning of the term “Status” (often as applied to equipment such as boilers and chillers, the meaning is not intuitively clear).
   a. When Status indicates presence or absence of an alarm, it must be labeled “Alarm Status”.
   b. When Status indicates an actual on/off or operating state of equipment, specifically indicate what status is being provided. For example, if the Status point reads whether the burner is firing or not, it must be labeled “Burner Status”; if the Status point reads whether a chiller compressor is On or not, it must be labeled “Compressor Status”; if the Status point simply indicates whether a piece of equipment has received an Enable command or not, it must be labeled “Status: Equipment Enabled”.

2.16 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network. The digital system controllers shall perform full control automation functions regardless of the condition of communications with the Central Operator's Station.

E. Environment Requirements:
   1. Controller hardware shall be suitable for the anticipated ambient conditions.
   2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
   3. Controllers located outdoors shall be rated for operation at 32 to 150 deg F.

F. Power and Noise Immunity:
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches (900 mm) of enclosure.

G. DDC Controller Spare Processing Capacity:
   1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
      a. Network Controllers: 50 percent.
      b. Programmable Application Controllers: Not less than 50 percent.
      c. Application-Specific Controllers: Not less than 50 percent.

   2. Memory shall support DDC controller's operating system and database and shall include the following:
      a. Monitoring and control.
      b. Energy management, operation and optimization applications.
      c. Alarm management.
      d. Historical trend data of all connected I/O points.

e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:
1. Network Controllers:
a. 20 percent of each AI, AO, BI, and BO points connected to controller.
b. Minimum Spare I/O Points per Controller:
1) AIs: Two.
2) AOs: Two.
3) BIs: Two.
4) BOs: Two.

2. Programmable Application Controllers:
a. Minimum Spare I/O Points per Controller:
1) AIs: Two.
2) AOs: Two.
3) BIs: Two.
4) BOs: Two.

3. Application-Specific Controllers:
a. Minimum Spare I/O Points per Controller:
1) AIs: Two.
2) AOs: Two.
3) BIs: Two.
4) BOs: Two.

2.17 NETWORK CONTROLLERS

A. General Network Controller Requirements:
1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Serviceability:
1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.18 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:
   1. Include adequate number of controllers to achieve performance indicated.
   2. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations. Controllers shall be configured to use stored default values to ensure fail-safe operation.
   3. Controller shall have enough memory to support its operating system, database, and programming requirements.
   4. Data shall be shared between networked controllers and other network devices.
   5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
   6. Controllers that perform scheduling shall have a real-time clock.
   7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
   8. Controllers shall be fully programmable.
   9. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
   10. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.19 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.
   1. Capable of standalone operation and shall continue to include control functions without being connected to network.
   2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

2.20 SENSORS & FIELD DEVICES

A. All sensors and field devices shall be of commercial grade quality and shall be installed according to the manufacturer's recommendations. Outdoor damper actuators shall be rated for exterior service and provided in weatherproof UV-inhibited housing.

B. Temperature Sensors (General)
   1. All temperature inputs for the automation system shall be derived directly from analog inputs from electronic temperature sensors. Transducing of pneumatic sensor signals shall not be acceptable.
   2. Temperature sensing elements shall be RTD type, thermistor type, or solid state sensors, as specified in drawings or points list. All sensors of a particular type shall be from the same manufacturer.
   3. Characteristics for temperature sensors:
      a. Interchangeability of +/- 0.2% at the reference temperature.

b. Time constant response to temperature change shall be less than three seconds per degree F.
c. Sensors shall be linear, drift free, and require only a one time calibration. Sensing elements shall be factory calibrated.
d. The sensing elements shall be hermetically sealed.
e. Additional linearizing, ranging, and lead length compensation may be accomplished in software if required to meet the accuracies specified within.

4. Expected temperature sensor operating range and end to end accuracy, including errors associated with sensor, transmitter (if applicable), leadwire and A/D conversion shall be as follows:

Sensed Element	Expected Oper. Range	Sensor Accuracy
a. Return air	40 to 100˚F	0.5˚F
b. Indoor space temperature	40 to 100˚F	0.5˚F
c. Outside air	0 to 125˚F	0.5˚F

C. Adjustable Limited Range Wall Temperature Sensors (Thermostats)

1. General: All wall sensors installed as part of this project shall have adjustable limited range setpoint adjustment function.
a. 10K-2-R-SOD (10K, DA, Cool / Warm, OVR). Override option shall be provided.
b. Setpoint limits shall be adjustable via the COS and password protected.
c. Unit shall have a built in processor and shall communicate with local controller.
d. Unit shall have an LCD display for space temperature and on / off state
e. Unit shall have a password protection function to restrict access to service mode.
f. Provide extra thermostats: 5 of each type.
2. Following areas shall have sensors with override option in addition to adjustable setpoint range function: all sensors in Administration, Gym, Hallways.

D. Humidity Sensors: Bulk polymer sensor element.

1. Bulk polymer sensor element. Install humidity sensors in the space and not in ductwork unless specifically noted. Coordinate locations of duct mounted sensors with Engineer.
a. Accuracy: 5 percent full range with linear output.
b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
c. Duct and Outside-Air Sensors: With element guard and mounting plate.

E. Carbon Dioxide (CO2) sensors:

1. CO2 sensor shall monitor indoor carbon dioxide (CO2) levels in accordance with ASHRAE standard 62-2004. Complete kit shall include optional aspiration box for mounting sensor inside return air duct.
2. Sensor shall have a 4 - 20 mA linear output over a range of 0 - 5000 ppm of CO2. A SPDT shall be provided for local control or alarm output.
3. **Provide sensor with LCD readout.**
4. Power: 24VAC or DC at 400mA max.
5. Measuring range: 0-2000 ppm
6. Accuracy: 40 ppm + 2% of reading
7. Analog output: 4-20 mA
8. Control relay: N.O. SPST, 0.75 amp at 24VAC/VDC
9. Operating temperature: 32° - 122°F
10. Operating humidity: 5-95% non-condensing
11. Calibration adjustment: zero to span
12. Min. req. calibration: One year

13. Unit enclosure: UL fire rated
14. Aspiration box: High impact styrene

F. Equipment operation sensors as follows:
1. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
2. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

G. Equipment on/off control shall use either momentary pulsed relays or magnetically latched relays, as appropriate for the equipment's control starter. Interfacing controls shall be configured such that in its last commanded state. All equipment safeties and interlocks shall remain active, and will not be bypassed by new EMS controls. For motors with VFDs provide On/Off Control as appropriate VFD terminals.

H. Motor On/Off Status: Unless otherwise specified, status shall be proven using current sensing relays connected at VFDs and calibrated for minimal operating speed.

I. Pressure Sensors: Pressure sensors and differential pressure sensors shall be piezo-resistive strain-gauge with temperature compensation. Sensors shall be selected to provide linear indication with an adequate span for the application. Sensor shall be 0 - 10 V or 4 - 20 mA. Insure sensors are rated to operate at temperature of sensed media. Sensors shall have an accuracy of 1% of full scale. Sensors shall accept overpressures of at least 120 psig, at any port, without damaging the sensor.

J. Watthour Transducers: Shall have an accuracy of +/- 2.5% at 0.5 power factor to 2.0% at 1 power factor for KW and KWH outputs. Output signals for KW and KWH shall be internally selectable without requiring the changing of current or potential transformers. Current and potential transformers shall be in accordance with ANSI C57.13.

K. Voltage Outputs: Variable voltage outputs shall provide a voltage signal from 0 to 20 volts. All voltage outputs shall be fuse protected against shorts to 120 volts AC and capable of withstanding a short ground indefinitely. All voltage outputs shall be protected against + or - 1500 volts, 50 microseconds transients. Voltage outputs shall have a resolution of 0.1 volts.

L. Current Outputs: Variable current outputs shall be a sinking type and shall provide 0 to 20 milliamps with a resolution of 0.1 mA and a compliance of 20 volts minimum. All current outputs shall be fuse protected to 120 volts AC and protected against + or - 1500 volts, 50 microsecond transients.

M. Pressure Sensors: Pressure sensors and differential pressure sensors shall be piezo-resistive strain-gauge with temperature compensation. Sensors shall be selected to provide linear indication with an adequate span for the application. Sensor shall be 0 - 10 V or 4 - 20 mA. Insure sensors are rated to operate at temperature of sensed media. Sensors shall have an accuracy of 1% of full scale. Sensors shall accept overpressures of at least 120 psig, at any port, without damaging the sensor.

N. Motor On/Off Status: Unless otherwise specified, status shall be proven using current sensing relays connected at VFDs and calibrated for minimal operating speed.

O. Hardware Overrides: A three position manual override switch shall allow selection of the ON, OFF, or AUTO outputs state for each output point. In addition, all analog output points shall be

equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

P. Damper Actuators
1. Electronic direct-coupled actuation shall be provided.
2. The actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assemble shall be of a 'V' bolt design with associated 'V' shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a 'V' clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches when the damper is constructed in this manner. Single bolt or screw type fasteners are not acceptable.
3. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the entire rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable.
4. For power failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Non-mechanical forms of fail-safe operation are not acceptable.
5. All spring return actuators shall be capable of both clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
6. Proportional actuators shall accept a 0 to 10VDC or 0 to 20mA control input and provide a 2 to 10VDC or 4 to 20mA operating range. An actuator capable of accepting a pulse width modulating control signal and providing full proportional operation of the damper is acceptable. All actuators shall provide a 2 to 10VDC position feedback signal.
7. All 24VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10VA for AC or more than 8 watts for DC applications. Actuators operating on 120VAC power shall not require more than 10VA. Actuators operating on 230VAC shall not require more than 11VA.
8. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque shall have a manual crank for this purpose.
9. All modulating actuators shall have an external, built-in switch to allow reversing direction of rotation.
10. Actuators shall be provided with a conduit fitting and a minimum 3ft electrical cable and shall be pre wired to eliminate the necessity of opening the actuator housing to make electrical connections.
11. Actuators shall be Underwriters Laboratories Standard 873 listed and Canadian Standards Association Class 4813 02 certified as meeting correct safety requirements and recognized industry standards.
12. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque and shall have a 2-year manufacturer's warranty, starting from the date of installation. Manufacturer shall be ISO9001 certified.

Q. Field Testing and Programming Equipment: A portable laptop or notebook computer shall interface via standard push-in connection at an asynchronous serial port located at the Control modules and at selected enhanced zone temperature sensors as indicated on project plans. This portable unit shall be capable of full global communications with all Control modules connected within the respective network and shall provide functionally identical user interface to the Workstation, in non-graphic format. Units shall be able to interrogate all points and alter all programming.

2.21 ENCLOSURES

A. General Enclosure Requirements:
   1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers. Do not house more than one controller in a single enclosure.
   2. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
   3. Enclosures shall be NRTL listed according to UL 508A.
   4. Enclosures constructed of steel, finished inside and out with polyester powder coating electrostatically applied and then baked to bond to substrate.
   5. Hinged door full size of front face of enclosure and supported using:
      a. Enclosures sizes less than 36 in. (900 mm) tall: Multiple butt hinges.
      b. Enclosures sizes 36 in. (900 mm) tall and larger: Continuous piano hinges.

B. Internal Arrangement:
   1. Internal layout of enclosure shall group and protect components associated with a controller, but not an integral part of controller.
   2. Arrange layout to group similar products together.
   3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
   4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
   5. Terminate field cable and wire using heavy-duty terminal blocks.
   6. Include spade lugs for stranded cable and wire.
   7. Install a maximum of two wires on each side of a terminal.
   8. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
   9. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
   10. Mount products within enclosure on removable internal panel(s).
   11. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch- (6-mm-) high lettering.
   12. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.

C. Environmental Requirements:
   1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
   2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
   3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
   4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
   5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.

6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

2.22 RELAYS

A. All:
1. Heavy duty, rated for at least 10 A at 250-V ac and 60 Hz.
2. Construct the contacts of either silver cadmium oxide or gold.
3. Relay enclosed in a dust-tight cover.
4. Coil transient suppression to limit transients to non-damaging levels.
5. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
6. Mechanical Life: At least 10 million cycles.
7. Electrical Life: At least 100,000 cycles at rated load.
8. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
9. Timing Ranges, where applicable: Multiple ranges from 0.1 seconds to 100 minutes.
10. Repeatability: Within 2 percent.
11. Recycle Time: 45 ms.
12. Minimum Pulse Width Control: 50 ms.
13. Power Consumption: 5 VA or less at 120-V ac.
14. Ambient Operating Temperatures: Minus 40 to 115 deg F (Minus 40 to 46 deg C).
15. General-Purpose Relays: With LED indication and a manual reset and push-to-test button.
16. Multifunction Time-Delay Relays: With knob and dial scale for setting delay time.

B. Current Sensing Relay:
1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current. Choose relay size to be able to read smallest current from motor at lowest speed.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

2.23 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

A. 250 through 1000 VA:
1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
3. UPS shall provide up to 15 minutes of battery power.
4. Performance:
   a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
   b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
   c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
   d. On Battery Output Voltage: Sine wave.
   e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.

f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
g. Transfer Time: 6 ms.
h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

5. UPS shall be automatic during fault or overload conditions.
6. Include front panel with power switch and visual indication of power, battery, fault and temperature.

2.24 SURGE PROTECTION

A. Zener diodes, silicone avalanche diode, optical isolation, varistors, or combination thereof.

B. Transient protection
1. Communications LAN:
a. Provide surge protection equipment sized specifically for expected operating current of LAN.
b. Exceeds severity level 4 of IEC 801-4.
c. Operating voltage: 12 volts.
d. Maximum operating current: 200 mA
e. Clamping action turn-on: 14.3 volts
f. Maximum clamping at 2 kW (8 x 20 microsecond wave): 22 volts
g. Maximum surge voltage: 20 kV
h. Maximum surge current (8 x 20 microsecond wave): 2.5 kA
i. Current leakage at perating voltage: 5 microamps
j. As manufactured by Surge Control Limited, SPR series, or approved equal.
2. Power supply:
a. Provide surge protection equipment sized specifically for expected operating current of DDC controller.
b. Exceed recommendations for ANSI / IEEE C62.41-1991 Categories A3 and B3 and UL1449.
c. Design such that suppressor does not "wear out" with repeated surges.
d. CSA certified and UL recognized.
e. EMI / RFI filtering.
f. Differential and common mode suppression and filtering.
g. Less than 5 nanosecond response time.
h. Maximum transient voltage 6 kV.
i. Maximum transient current 3 kA.
j. Minimum clamping turn-on, 210 volts.
k. Maximum clamping voltage, (l-test):
1) line to neutral — 245 volts.
2) line to ground — 245 volts.
3) neutral to ground — 245 volts.
l. Maximum clamping voltage @ 3 kA:
1) line to neutral — 325 volts.
2) line to ground — 430 volts.
3) neutral to ground — 430 volts.
m. As manufactured by Surge Control Limited, SPP-1200 series, or approved equal.

C. Protective devices shall be continuous duty, automatic and self restoring.

2.25 CONTROL WIRE AND CABLE

A. 7/24 soft annealed copper strand with a 2- to 2.5-inch (50- to 65-mm) lay.

B. Plenum rated LAN and Communication Cable complying with NFPA 70 and DDC system manufacturer requirements for network being installed.

2.26 CONTROL POWER WIRING AND RACEWAYS

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

B. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

2.27 IDENTIFICATION

A. Provide engraved phenolic tag, fastened with drive pins with min. 0.5" high white lettering on black background, bearing unique identification nomenclature for control equipment and devices.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Schedule and attend conference at location of owner's choosing. Mandatory attendees include representatives from BAS contractor, Owner, Engineer, and Commissioning Authority.

3.2 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify compatibility with and suitability of substrates. Examine roughing-in for products to verify actual locations of connections before installation. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

B. Prepare written report listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Review proposed control sequences for reasonableness and ability to be programmed. For any sequences which contractor believes are incorrect, unworkable, or incapable of being programmed, clarify with Engineer via RFI prior to uploading control program.

3.3 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Coordinate with Owner for provision of required communication infrastructure that is Owner's responsibility, including data drops, IP addresses, etc.

B. Communication Interface to Equipment with Integral Controls: DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control. Reference drawings for equipment to be connected.

3.4 GENERAL INSTALLATION REQUIREMENTS

A. The I/O Summary on the drawings is provided as a list of the minimum points required. Provide all controls points, temperature sensors, relays, actuators, and devices necessary to achieve operational sequences at no additional cost to the Owner, whether explicitly called for or not in this specification. Coordinate with all sub-contractors to ensure all items are provided and installed.
   1. Controlled and/or monitored points required for proper operation of units may differ by unit manufacturer. If HVAC or other equipment ultimately installed differs from that specified, provide controlled and monitored points required for proper operation as determined by equipment supplier and Engineer.

B. Install in accordance with manufacturer's instructions.

C. Controls Contractor is responsible for complete operational installation of system, including, but not limited to the following:
   1. Electrical power supply to all control system components, including but not limited to; controllers, actuators, sensors, from dedicated circuits in electrical panels.
   2. Complete installation of duct-mounted components, including but not limited to: temperature, relative humidity, pressure, and CO2 sensors, and dampers/actuators.
   3. Complete installation of pipe-mounted components, including but not limited to: control valves and actuators, temperature sensors, pressure sensors.

D. All electrical material and installation shall be in accordance with local applicable codes and requirements of Division 26. All automation system equipment supplied shall be provided with adequate grounding in accordance with the manufacturer's specifications and suggested engineering applications procedures. These requirements shall include, but not be limited to:
   1. A "clean earth ground" for all FCUs and central operator's station.
   2. No "ground mixing" between equipment components.
   3. Insulation of all panels from metal conduits.
   4. Equal-potential grounding for equipment where required.

E. Identification:
   1. Provide a permanent, stick-on tape marker on the inside cover of the space sensor (e.g. temperature, RH) to identify the name of the HVAC unit associated with the sensor.
   2. Provide within each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature for that particular controller.
   3. Label each end of cable, wire and tubing in enclosures following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection. **Use printed labels, not hand-written.**
   4. Identify all controller enclosures with 1/8 inch thick plastic labels not less than 3 x 1.25 inches. Fasten with stainless-steel rivets or self-tapping screws or contact-type permanent adhesive, compatible with label and with substrate

F. Install products to satisfy more stringent of all requirements indicated.

G. Install products level, plumb, parallel, and perpendicular with building construction. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment.

H. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

I. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

J. Seal penetrations made in fire-rated assemblies and in acoustically rated assemblies in accordance with applicable fire codes.

K. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

L. Install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

M. Corrosive Environments:
   1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

      a. Laboratory exhaust-air streams.
      b. Process exhaust-air streams.

   2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
   3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.5 CONTROLLER INSTALLATION

A. Quantity and location of network and programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.

B. Install controllers in enclosures to comply with indicated requirements in a protected location that is easily accessible by operators.

C. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 DDC SYSTEM I/O CHECKOUT, ADJUSTMENT, CALIBRATION AND TESTING

A. Prepare and submit a report to Engineer and Commissioning Authority documenting results for checking, adjustment, calibration, testing. Include a description of corrective measures and adjustments made to achieve desire results for each I/O point, control sequence, and system.

B. Sensor Check and Calibration:
   1. Sensor Check and Calibration: Coordinate with Testing, adjusting, and balancing (TAB) firm to calibrate all sensors and provide report of findings.
      a. All sensors not accurate within range specified and submitted are to be replaced.
      b. Add an offset to those sensors which are inaccurate, but are within specified and submitted range, so that they read accurately.
      c. CO2 sensors' calibration is typically verified by TAB contractor at a single point in time, and does not prove accuracy at higher or lower ends of the sensors' expected operating range. Contractor must verify sensor accuracy at high and low ends of expected range by the following means:
         1) Low end: Take CO2 sensor readings near the end of a 3-day period when school has been mostly or entire unoccupied, and prior to its being re-occupied. CO2 should read in the 410 – 440 ppm range. Unless contractor knows of logical reason sensors should read outside this range, make sensor adjustment / replacement as per a. and b. above.
         2) High end: Observe CO2 sensor readings over a minimum of 5 days when school is heavily occupied. CO2 should read no higher than 1200 – 1400 ppm. For sensors which read higher than 1400ppm for any period of time > 20 minutes:
            a) Verify proper operation of HVAC equipment responsible for providing outside air ventilation. **Coordinate this verification in conjunction with mechanical (other other) subcontractor, as the issue may be due to improper mechanical operation.**
            b) Re-verify sensor accuracy at a time when it is reading at a high (1300ppm or greater) value.
            c) Make sensor adjustment / replacement as per a. and b. above.

C. Control Damper Checkout:

   1. Verify that control dampers are installed correctly for flow direction.
   2. Verify that proper blade alignment, either parallel or opposed, has been provided.
   3. Verify that damper frame attachment is properly secured and sealed.
   4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
   5. Stroke and adjust control dampers following manufacturer's recommendation, from 100 percent open to 100 percent closed and back to 100 percent open. Verify that damper blade travel is unobstructed and that damper actuator and linkage attachment is secure.
   6. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.

7. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

D. Switches: Calibrate switches to make or break contact at set points indicated.

E. Controllers:
1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.
7. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.
8. Verify that spare I/O capacity is provided.
9. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance. Test every I/O point throughout its full operating range.
10. Test every control loop to verify operation is stable and accurate.
11. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
12. Test and adjust every control loop for proper operation according to sequence of operation.
13. Test software and hardware interlocks for proper operation. Correct deficiencies.
14. Operate each analog point at upper, mid, and lower portions of range
15. Exercise each binary point.
16. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.

3.8 DDC SYSTEM COMMISSIONING TESTS

A. Provide written request to Commissioning Authority (CxA) for initiation of on-site Functional Testing. Functional Testing will not take place until:
1. System has been thoroughly tested as described in this section under “DDC System I/O Checkout, Adjustment, Calibration, And Testing”, and report has been submitted.
2. Certificate of Readiness has been submitted to CxA.
   a. Submit Certificate of Readiness only when confirmed that system is operating perfectly, and in accordance with specifications and drawings requirements. Only minor exceptions to this requirement are allowable, and must be clearly described in the submitted Certificate of Readiness
   b. At his discretion, if entire control system has not been completed, CxA may test portions of system which have been completed.

3. Prefunctional Checklists, if required by contract documents, have been submitted to CxA.

B. Contractor shall set up trend logs as requested by the CxA, Engineer, or Owner, without any limits on the number of trends, to assist in testing and verification of system operation.
1. Prior to start of functional testing, set up trend logs as follows (* *as applicable* to systems, equipment, and BAS points provided on this project):

a. Set all trend logs to record and maintain minimum 72 hours worth of readings.
b. All CHW air handlers: Trend the following points, as applicable to unit:
    1) Readings every change of value:
        a) Fan status
    2) Readings every 2 minutes:
        a) Return air CHW coil leaving air temperature
        b) Outside air CHW coil leaving air temperature
        c) Mixed air temperature
        d) Heater status
        e) Unit discharge air temperature (might be same as heater leaving air temperature)
        f) Heater leaving air temperature (might be same as unit discharge air temperature)
    3) Readings every 15 minutes:
        a) Static pressure
        b) Static pressure setpoint
        c) Fan speed
        d) Space temperature
        e) Return air temperature
        f) Return air relative humidity
        g) Return air and/or space CO2
        h) Outside air damper position
        i) Outside air temperature
c. All DX package and split systems: Trend following points, as applicable to unit:
    1) Readings every change of value:
        a) Fan status
        b) Compressor status, each stage or each compressor
        c) Reheat / dehumidification status
        d) Heater status (stepped heaters), each stage
        e) Heater status (SCR), each 15% COV
    2) Readings every 2 minutes:
        a) Unit discharge air temperature
        b) DX cooling coil leaving air temperature
        c) Outside air CHW coil leaving air temperature
    3) Readings every 15 minutes:
        a) Static pressure
        b) Static pressure setpoint
        c) Fan speed
        d) Space temperature
        e) Return air temperature
        f) Return air relative humidity
        g) Return air and/or space CO2
        h) Outside air damper position
        i) Outside air temperature
d. Variable air volume boxes: Trend the following points, as applicable to unit:
    1) Readings every change of value:
        a) Fan status (fan-powered box)
        b) Heater status (stepped heaters), each stage
        c) Heater status (SCR), each 15% COV
    2) Readings every 5 minutes:
        a) Unit discharge air temperature
    3) Readings every 15 minutes:
        a) Space temperature

b) Space relative humidity
c) Space CO2
d) Damper position
e) CFM
f) CFM setpoint

e. Exhaust & ventilation fans: Trend the following points, as applicable to unit:
1) Readings every change of value:
a) Fan status
b) Fan Command (on/off or Off/Enable)

f. Electric Power Meters: Trend the following points, as applicable:
1) Readings every 15 minutes:
a) kW
b) Power Factor
c) Amps, all legs

C. CxA will perform on-site and remote Functional Testing as specified in Construction Documents and in accordance with generally accepted commissioning procedures. DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated. Reference section 019113 "General Commissioning Requirements" for more information.
1. Contractor is to provide a qualified representative, intimately familiar with the project installation and issues, to carry out Functional Testing procedures as directed by CxA, for the duration of Functional Testing.

D. CxA will issue reports to Contractor, in such forms as Commissioning Issues Logs, emails, written reports, detailing items which appear not to be in conformance with construction documents requirements. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

E. Due to the complexity of control systems and potential for latent defects to go undiscovered during Functional Testing, DDC system or tested portions thereof must operate essentially trouble-free for a period of 30 consecutive days following Functional Testing before Final Acceptance of system will be granted.

3.9 WARRANTY SERVICE

A. System deficiencies discovered subsequent to Final Acceptance of system will be treated as Warranty items. Under Warranty requirements, address all operating problems, repair or replace worn or defective components, adjust control parameters as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Provide system inspections and reports annually during warranty period; reference Part 1 paragraph "Warranty Inspections" in this specifications section.

3.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning **at Final Acceptance of system**, service agreement shall include software support for two year(s).

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of **Final**

Acceptance of system. Upgrading software shall include operating system and new or revised licenses for using software.

3.11 DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system. Owner may send up to 10 persons to attend training. Training shall occur within normal business hours at a mutually agreed on time.

B. Provide not less than **14** hours of training total, broken up into four 3.5 hour sessions. Provide staggered training schedule as requested by Owner to accommodate Owner personnel schedules.

C. Schedule training with Owner at least four business days before expected Substantial Completion. All training shall occur before Final Acceptance of control system.

D. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate daily operators, advanced operators, and system managers and administrators.

E. Provide each attendee with a color hard copy of all training materials and visual presentations. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter.

F. Instructor Requirements:
1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have not less than three years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

G. On-Site Training:
1. Provide as much of training located on-site as deemed feasible and practical by Owner. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. On-site training shall include regular walk-through tours to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
4. Operator workstation shall be used in training, whether Owner’s or contractor-provided & via remote web access.

H. Training Content:
1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.

8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals, and control drawings.
11. Accessing data from DDC controllers.
12. Operating portable operator workstations.
13. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
14. Running each specified report and log, setting up Trend Logs.
15. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
16. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
17. Executing digital and analog commands in graphic mode.
18. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
19. Demonstrating DDC system performance through trend logs and command tracing.
20. Demonstrating scan, update, and alarm responsiveness.
21. Demonstrating spreadsheet and curve plot software, and its integration with database.
22. Demonstrating on-line user guide, and help function and mail facility.
23. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
24. Demonstrating operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
25. Demonstrating integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.

I. Maintain a training attendee list and sign-in sheet. Sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
   1. For each session, submit a scanned copy (PDF) of circulated sign-in sheet to Owner, Engineer, and Commissioning Authority with 48 hours of end of training session. **THE SIGN-IN SHEET PROVIDED FOR CONTRACTOR ON THE LAST PAGE OF THIS SPECIFICATION MUST BE USED. FAILURE TO TURN IN ACCEPTABLE DOCUMENTATION OF TRAINING ON THE PROVIDED TRAINING SIGN-IN SHEET WILL BE TREATED AS IF NO TRAINING TOOK PLACE. CONTRACTOR WILL BE REQUIRED TO PROVIDE AND DOCUMENT ADDITIONAL TRAINING AS SPECIFIED ABOVE.**

TRAINING SIGN-IN SHEET

NAME OF FACILITY: _____

SYSTEM TRAINED: **230900 – INSTRUMENTATION AND CONTROLS**

TRAINER _____
person's name Organization

TRAINING DATE: _____

START / END TIME: Start: End:

TRAINING LOCATION: _____

IN ATTENDANCE (printed name)	SIGNATURE	ORGANIZATION

I CONFIRM TRAINING AS INDICATED ABOVE TOOK PLACE AND WAS SATISFACTORY.

OWNER'S REPRESENTATIVE SIGNATURE _____

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
2. Division 23 Sections for DX Split Systems

1.2 ABBREVIATIONS

A. Abbreviations used in this specifications section:
1. BAS: Building Automation System
2. CO2: Carbon Dioxide
3. CxA: Commissioning Agent
4. DAT: Discharge Air Temperature
5. DCV: Demand Control Ventilation
6. DDC: Direct Digital Control
7. dP: differential Pressure
8. dT: differential Temperature
9. DX: Direct Expansion
10. EF: Exhaust fan
11. OA: Outside Air
12. RH: Relative Humidity
13. TAB: Testing, Adjusting and Balancing

1.3 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment. Provide controls and operating sequences for the following HVAC systems at **Idea Public School, San Benito Campus**:
1. Replace existing controls with new BAS in its entirety. Approximate quantities of equipment are listed. Verify on plans and on site, prior to submitting bids. Provide new controls for existing and new equipment, including, but not limited to:
2. Building B:
   a. AHU/ACCUs-2, 3. MZ VAV with VFDs and bypass dampers
      1) Verify number of cooling stages and number of bypass dampers (master-slave configuration)
   b. VAVs: 16 (Verify on site)
   c. EFs: 5 (verify fans that are two-speed lab fans)
3. Building C:
   a. AHU/ACCUs- 1. MZ VAV with VFDs and bypass dampers

1) Verify number of cooling stages and number of bypass dampers (master-slave configuration)
   b. CC/ACCU-1
   c. VAVs: 19
   d. EFs: 2
4. Building E:
   a. AHU/ACCUs- 4, 5, SZ VAV with Electric Duct Heaters (EDH): AHU-4 has staged EDH, and AHU-5 has SCR EDH. Verify number of cooling stages and heater configuration (SCR or number of stages)
   b. EFs: 4
   c. Domestic Hot Water
   d. Electric Metering: Provide new meter.
5. Common to All Buildings:
   a. DX Split Systems: Multizone VAV AHUs with VAV boxes and bypass dampers.
   b. DX Split Systems: Single zone VAV AHUs without VAV boxes, with EDH
   c. DX Split Systems: Single zone CAV AHUs without VAV boxes, with EDH
   d. VAV Boxes
   e. Small Split Systems (<5T)
   f. Exhaust Fans: Includes 2 speed fans for labs.
   g. Domestic Hot Water
   h. Electric Metering
6. Systems shall be fully controlled by new BAS. Equipment manufacturer's integral unitary controller shall monitor alarms, safeties, and internal delays.
7. Provide controllers, control points, sensors, damper actuators, end devices, contactors, relays, CTs, wiring, enclosures, engineering, programming, sequences, graphics, and appurtenances as required to control new and existing equipment.
8. BAS shall provide new space sensors, including but not limited to, adjustable limited range, temperature with LCD display, RH, and CO2.
9. Provide dedicated graphics pages to display BACnet parameters such as alarm status, codes, and other parameters selected by the engineer and CXA. Coordinate details with equipment manufacturer and engineer.
10. System Commissioning.

B. **Prior to bidding**, BAS contractor shall coordinate with equipment supplier and notify general, mechanical and electrical contractor of any work required for operational installation of controls devices that will not be conducted by Controls Contractor. This includes, but is not limited to: installation of controls devices and sensors, and any needs for power wiring and/or conduit.

C. A list of the minimum number and type of control points required is given. Provide any additional points, sensors, gateways, interface cards, etc. as required to achieve sequences, whether specifically called for in Points List or not.

D. All equipment must be listed in strict alpha-numeric order when presented as a part of any tables, summaries, global searches, etc. (For example, to ensure this, unit numbers should begin with **0**, such as VAV-**0**6-02, so that they appear in the list prior to units with numbers -10, -11, -12, etc.)

E. Provide all hardware, software, and labor required to achieve specified sequences.

F. Units or systems that are grouped together for purposes of sequence description are not meant to be controlled together. Each system shall have its own set of adjustable parameters and will

respond only to values (space temperatures for example) associated with it. This means that one unit may be in heating mode while another with similar sequence may be in cooling mode.

1.4 EQUIPMENT TIME SCHEDULES

A. Contractor is responsible for programming schedules for all equipment and systems prior to turning system over to Owner at final system acceptance.

B. Initial Construction Time Schedules
   1. Match existing time schedules.
   2. In general, HVAC systems should not operate in normal Occupied mode on weekends, nor for more than 12 hours on any Mon-Fri weekday, unless expressly directed to do so by the Owner, and only for special purposes.
   3. Inform the CxA of any such special scheduling directions, and of the target date the special schedule will be lifted.

C. Consult with Owner to determine Owner's desired equipment operating schedules, including both Normal and upcoming Holiday schedules, and Program holiday time schedules as per Owner's direction. Immediately after determining Owner's desired schedules, inform CxA in writing of what those schedules are.
   1. Independent dedicated operating schedules MUST be provided for groups of equipment that serve similar floor areas with similar usage patterns. At minimum, provide such dedicated schedules for the following:
      a. Cafeterias
      b. Kitchens
      c. Classrooms on floor 1
      d. Classrooms on floor 2
      e. Auditoriums
      f. Libraries

D. Optimum Start/Stop (OSS)
   1. The purpose of OSS is to cause the control system to calculate an optimal start time for HVAC so that comfort conditions will be achieved by the scheduled Occupied time.
   2. Do not implement OSS programming for HVAC control unless specifically requested by Owner.
   3. Should Owner indicate desire that OSS be implemented:
      a. Owner must be fully informed of how OSS works; arrange a conference call with Owner and CxA to discuss.
      b. Inform the CxA in writing of Owner directions, and of the target date the special schedule will be lifted.
      c. Program an OSS 'inhibit time' preventing start of unit more than 20 minutes prior to target comfort time.

E. Outside air dampers, exhaust fans, or other equipment devices have independent dedicated time schedule different from the equipment which they serve or are associated with. For example, distinct time schedules are required for actual Occupied time requiring ventilation versus required equipment start/stop times for comfort. Set schedules initially for
   1. OA dampers open / EF On at 7 AM (adj) on all days that associated AHU is operational.
   2. OA dampers close / EF Off 30 min (adj) prior to associated AHU Off time.
   3. Consult with Owner as to whether different schedules are desired and set that program.

F. Equipment items having the same Off/Enable or Start/Stop times are not to be software interlinked such that one cannot be changed without changing the other. Each individual equipment item is to have its own individual programmable Off/Enable or Start/Stop scheduling capability.

G. Stagger unit start times by a minimum of 20 seconds between starts.

H. Unoccupied hours, Off / Enable:
   1. Enable cooling if space air temperature rises above 90˚F (adj.). Disable unit once temperature has fallen to 85˚F (adj.) or below.
   2. Enable heating if space air temperature drops below 45˚F (adj.). Disable unit once temperature has risen to 55˚F (adj.).
   3. Enable cooling if relative humidity rises above 60% (adj.). Disable unit once relative humidity has fallen to 55% (adj.).
   4. Unit shall run for a minimum of 30 min. (adj.) or until specified conditions are satisfied.
   5. Issue Alarm if the unit has been in unoccupied mode for 4 hours (adj) and relative humidity rises above 60% (adj.). This time delay should allow false alarms immediately after units are disabled.
   6. Manual Override: Control may be manually overridden at the zone Thermostat, controller and the COS.
   7. Hardware Interlocks: Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.

1.5 SPACE SETPOINTS

A. Temperature and humidity setpoints and operating schedules listed in sequences of operations are initial values, based upon input from Owner's representatives and common industry practice, and are not to be considered as final. Final setpoint and schedules must be programmed as per Owner's direction, and with approval of Owner and/or Engineer and Testing and Balancing firm, regardless of schedules listed in this specification.

B. In consultation with Owner and/or Engineer, and Testing and Balancing firm, make minor revisions to operating sequences which will result in improved operation of systems.

C. All adjustable setpoint temperature sensors / thermostats are to be set and software limited as to the range heating and cooling setpoint which building occupants may reset. Initial values are listed in control sequences. Determine final limits in consultation with Owner and Engineer.

D. Whether in Occupied or Unoccupied mode, the active heating setpoint must always be lower than the active cooling setpoint by a minimum of 5F, or higher if called for in sequences. This differential is referred to as the "deadband".
   1. With exception of that required for dehumidification, no heating operation is to take place when room temperature is within deadband. Operation of hot water coil or electric reheat is to begin only when room temperature has fallen 1˚F below the heating setpoint.
   2. Cooling operation within the deadband must be at an absolute minimum, ie. specified minimum air flow to provide necessary ventilation.

E. Room Temperature Setpoints
   1. Allowable range for space temperature setpoints will be limited via control system.

a. Program temperature setpoints to be set only at the central operator station, and not be adjustable at the zone thermostat.

2. System is expected to maintain room temperature no more than 0.75F above cooling setpoint / below heating setpoint during 'normal' steady-state operating conditions.
3. Unless otherwise noted in drawings or operating sequences described below, program the following room temperature setpoints for all heating and cooling equipment.
   a. Occupied Hours
      1) Cooling setpoint = 74F
      2) Heating setpoint = 69F
   b. Unoccupied Hours
      1) Cooling setpoint = 86F
      2) Heating setpoint = 59F
      3) Run unit for a minimum 20 minutes. Disable unit once temperature has fallen 3F below Cooling or 3F above heating setpoint.

F. Room Relative Humidity (RH) Setpoints
1. System is expected to begin dehumidification sequence when space RH reaches RH setpoint.
2. Unless otherwise noted in drawings or operating sequences described below, program the following room RH setpoints for all cooling equipment.
   a. Occupied Hours
      1) Cooling RH setpoint = 59%
      2) Run unit for a minimum 5 minutes. Disable dehumidification mode once RH has fallen 3% below setpoint.
   b. Unoccupied Hours
      1) Cooling setpoint = 65%

G. Room CO2 Setpoints
1. Unless otherwise noted in drawings or operating sequences described below, program the following room CO2 setpoints for all HVAC equipment with CO2 control capability serving individual rooms where DCV is specified:
   a. Occupied Hours
      1) Minimum setpoint = 900ppm, corresponding to minimum OA intake. Coordinate with manufacturer to set this via the unit controller UI.
      2) Maximum setpoint = 1100ppm, corresponding to maximum OA intake (equal to design OA CFM).
      3) Program system so that min and max setpoints may be adjusted by system operator via Global Command.
   b. Unoccupied Hours
      1) Not applicable.

1.6 BACNET CONNECTIONS

A. BACnet integration will be used for monitoring of parameters, specialized alarms with alarm codes that are sensed by the unitary controller:
1. All points readable within equipment BACnet register are to be communicated to and readable by BAS.
2. Provide a dedicated graphic page to display selected BACnet points. Navigate to this dedicated graphic by clicking on the equipment icon.

3. The point descriptor text for all BACnet points displayed on the dedicated BACnet page are to have clear, unambiguous meaning; simply copying manufacturer's text descriptor may not be acceptable. Supply manufacturer's points text descriptors to Engineer for pre-approval. Revise descriptors if directed by Engineer.
4. Supply manufacturer's points text descriptors to Engineer for pre-approval. Revise descriptors if directed by Engineer.
    a. Not all BACnet points potentially available from HVAC units are to be read by the BAS. Choose only those points which are applicable to the specific units installed and applicable to the specified operating sequences. If such points are not readily discernable, obtain clarification from unit supplier and Engineer. Provide Engineer list of such proposed points for approval prior to installation. Revise these points based on Engineer's direction based upon points' importance to unit operation.
5. Display all values with proper units (deg F, psig, etc.), truncated to decimal point accuracy commensurate with accuracy of sensor. See Section 230900.

1.7 OUTDOOR AIR CONDITIONS

A. Outdoor air temperature and relative humidity are to be read from an Engineer-approved web-based weather service such as Accuweather.com. Update conditions at no longer than the minimum update time provided by national weather service.

B. Display OA temperature and RH conditions on all graphics screens. Display values rounded to nearest whole number.

1.8 GENERAL

A. Individual sequence descriptions may list units to which sequence applies. Contractor must verify equipment quantities and unit types through drawings review and on-site inspections.

B. All setpoints used in controls sequences shall be user adjustable with a minimum of keystrokes.

C. Points lists have been provided as a general guideline, and are not all inclusive. Provide all points required for achievement of operating sequences.

D. All delays shall be operator adjustable. Program for a minimum delay between on/off commands for HVAC equipment to prevent short cycling.

E. Unless noted otherwise, program for minimum VFD speed of 30% of full 60hz speed.

F. Unless noted otherwise, close HVAC unit outside air dampers during all Unoccupied periods.

G. Economizer Operation:
1. For units with return air: During Occupied periods when system is in cooling mode, place unit in Economizer mode when:
    a. OA enthalpy is less than 23 Btu/lbm and equal or less than return air enthalpy; or
    b. OA dew point temperature is less than 54F and equal or less than dewpoint of return air enthalpy.
2. For dedicated outside air units: During Occupied periods when system is in cooling mode, place unit in Economizer mode when:

a. OA enthalpy is less than 23 Btu/lbm or OA air dew point temp is less than 54F.

3. Economizer operation is to be based upon global OA values, as described in "OUTDOOR AIR CONDITIONS" above, and not on OA values measured directly at the unit, unless specifically noted otherwise.

H. Interlocks:
1. Hardware: Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.
2. Provide all hardware necessary to achieve software interlocks required for proper system operation, including but not limited to control of dampers and exhaust fans. Coordinate with mechanical and electrical contractors.

I. AHUs:
1. Coordinate with TAB to obtain RA and OA damper positions at different fan speeds. This will allow the AHUs to bring in the scheduled OA airflow as needed, irrespective of the AHU fan speed.

J. VFD: NA

K. Operator Station Display: Indicate the following on operator workstation display terminal, as applicable per points list:
1. Building floor plan, indicating individual rooms, temperature, RH, and CO2 sensor locations, and areas served by each air handler, fan coil unit and rooftop unit. Place sensor information strategically on the floor plan and draw in lines of zone separation on floor plan as required to make it unambiguously clear which sensor values apply to which room.
2. Conditioned space air temperature, all zones.
3. Conditioned space air Base temperature setpoint, all zones.
4. Conditioned space air Effective temperature setpoint, all zones.
5. Distinguish different area(s) served by individual HVAC equipment items by use of color variation or heavy lines on floor plans graphics page.
6. When a control point is in "Test" or "Forced" mode, graphic shall clearly indicate this status by descriptive text, color change, or other similar means.

1.9 SUMMARY TABLES

A. Provide a dedicated graphic page for a summary table for each type of HVAC equipment for which there are two or more types (e.g. rooftop units, fan-coil units, etc.).
1. Provide a master navigation button on main dashboard graphic page to take one to these tables.
2. Provide tables using format and headers as in the following Sample tables:

	1	2	3	4	5	6	7	8
DX RTU w/ Reheat Summary table								
RTU	Space Temp	Compr Stages On	Unit DAT	Space RH	Dehum Status	Ret Air CO2	OA Dmpr % open	Heat Status
RTU-126	74	1	54	54%	Off	750 (1)	44%	Off (2)

Exhaust Fans		
	Space(s)	Fan

Equipment	Served	Command	Status	Speed
EF-1	Art Rm 123	On (4)	On	Low (5)

Notes

(1) If no CO2 sensor exists, put "NA" in column.
(2) If SCR type, list %. If staged, list On or Off.
(3) If unit has no heat, put "NA" in column. If NO units in project have heat, omit column.
(4) List as On or Off, or as Enable or Disable, as appropriate.
(5) For all single speed fans, list "NA", list High or Low for 2-speed fans.

1.10 ALARMS

A. Alarms shall be read and displayed on graphics screens for conditions described in this section.
   1. The graphic screen for each piece of HVAC equipment must have a dedicated line for Alarm condition, and all alarms must be enunciated on the graphic screen when they occur.
   2. For CRITICAL alarms listed below, designated representatives of owner must be sent alarm messages **via text and email**. The alarm message must clearly indicate the campus, the particular piece of HVAC equipment for which alarm occurred, the date and time it occurred, and the nature of the alarm.
   3. All alarm setpoints are to be easily adjustable via operator interface. Controls provider will change all such setpoints, at Engineer's direction, should actual conditions warrant different settings.
   4. All alarms are to be predicated on the equipment or system being ON and having been operational sufficient time to have stabilized. (E.g. when a chiller first starts in the morning, it may take 30 minutes to achieve chilled supply water temperature setpoint; no alarms are to be initiated during that time.)

B. General Alarm requirements:
   1. Alarms described below are for multiple types of HVAC and other systems. Program as applicable for equipment which exists on this project.
   2. Except as otherwise noted below, no alarms are to be generated for equipment or sensors during Unoccupied hours.
   3. All alarm setpoints are to be easily adjustable by Operator via global commands.
   4. A delay (suggested 20 minutes) is to be incorporated before alarms are generated immediately following HVAC equipment startup in order to give equipment time to obtain desired conditions. If the programmed delay time proves inadequate to prevent nuisance alarms at equipment startup, Controls contractor must verify what delay time is appropriate, and whether such alarms are caused by mechanical issues.
   5. Alarms are to be set up scrupulously to avoid generation of nuisance alarms, e.g. alarms read from HVAC units which repeatedly fail to start, generating a new alarm each time
   6. ALARM DESCRIPTIONS MUST BE CLEARLY GIVEN IN HISTORICAL ALARMS REGISTER TO INDICATE THE NAME OF THE ITEM CAUSING THE ALARM. This description must be plainly displayed without the requirement of having to 'hover' the cursor over the alarm line in the alarm history register.
   7. Where control system connects via Bacnet to a controller of an HVAC unit, in addition to simple on/off status of alarm, alarm codes are to be read and displayed by the BAS. Provide a dedicated graphic page to list description of alarm codes.

C. Critical HVAC Alarms:
   1. Control system will send alarm notifications via text message and email to designated Owner personnel for Critical HVAC alarms for the following:
      a. When dedicated outside air coil leaving air temperature deviates from setpoint by 1.5F for 15 consecutive minutes.
      b. Any additional Critical HVAC alarms designated by engineer or owner's facility manager (FM).

D. CO2 alarms:
   1. Register alarm any time, during occupied or unoccupied hours, that a sensor reads outside of the following Minimum / Maximum expected values indicating sensor is likely malfunctioning: 360 ppm / 1950 ppm.
   2. Register alarm when any CO2 sensor (for examples, space or return duct) reads above 1300ppm for 15 consecutive minutes.
      a. Program system to all alarm setpoint to be adjustable via a Global Command.

E. Space temperature alarms:
   1. Register alarm any time, during occupied or unoccupied hours, that a sensor reads outside of the following Minimum / Maximum expected values indicating sensor is likely malfunctioning: 45F / 100F.

F. Relative Humidity (RH) alarms:
   1. Register alarm any time, during occupied or unoccupied hours, that a sensor reads outside of the following Minimum / Maximum expected values indicating sensor is likely malfunctioning: 10% / 100%.

G. For all HVAC units (including exhaust or ventilation fans), register alarms under the following conditions (where applicable to particular unit):
   1. Discrepancy between commanded state of operation and actual state of operation, as indicated by status feedback.
   2. Discharge air temperature from an electric heating coil fails to rise by 5F within 15 minutes after heater is enabled.
   3. Outside air coil leaving air temperature remains below 35F for 5 consecutive minutes.
   4. Unit has tripped on any safety (e.g., high static pressure, freezestat).
   5. Duct static remains above 3" for 15 consecutive seconds; shut down air handler.
   6. Duct static pressure deviates above or below setpoint by 20% of setpoint for more than 15 minutes.

H. Register alarms for other equipment (e.g. refrigerant monitor, low or high static cutout switches, low temperature safety cutouts, etc.) when monitored alarm contacts close.

I. For all utility controllers, register alarms under the following conditions:
   1. System has been set to Purge mode.
   2. System remains in Purge mode for more than 30 consecutive minutes.
   3. Fan remains at high speed for more than 30 consecutive minutes.

J. Smoke Control: Smoke detector, where existing on HVAC units, stops fan when products of combustion are detected in air stream.
   1. Fan will be stopped directly via fire alarm system.
   2. BAS is not required to monitor smoke detector status.

3. Stopping of fan by fire alarm system automatically signals alarm due to Command-Status mismatch at BAS.

K. **ALL** HVAC equipment items:
1. Command/status mismatch for any component (e.g. fan, motor, heater, etc.)
2. Safety alarms:
   a. Low mixed air temperature: < 35F for 2 minutes.
   b. High leaving air temperature: > 120F for 10 consecutive minutes.
   c. High duct static pressure, when measured analog:
      1) > 3" wc for 15 seconds.
   d. High duct static pressure, when via binary mechanical switch monitored by BAS: On/Off alarm status, set to trip at 3.5" wc.
   e. Safety alarms are to be programmed to shut down equipment.

L. ALL analog sensors (CO2, temperature, humidity, pressure, etc.):
1. Sensor gives a reading outside of its normally expected range of:
   a. Space temperature, indoor conditions: 45F to 100F.
   b. Outdoor air conditions: 15F to 120F, 10% to 100%.
   c. Relative Humidity, indoor conditions: 15% to 80%.
   d. CO2, indoor conditions: 365 to 1950 ppm. [sensors reading < 400ppm but within the submitted and specified accuracy (as an example, 40ppm ±2% of reading) must have an offset programmed such that they bottom out at no less than 400ppm]
   e. Duct static pressure: -0.05" to 4.0".
   f. Hydronic static or differential pressure: -1 to 100 psig.
2. Relative humidity sensors:
   a. RH rises 10 percentage points above setpoint for 30 consecutive minutes.
3. Carbon Dioxide sensors:
   a. CO2 concentration rises above setpoint by 250ppm and remains so for 20 consecutive minutes.
4. Duct static sensor:
   a. Pressure deviates from setpoint (by 0.20") for more than 15 consecutive minutes.

M. Any equipment with BAS-BACnet communication specified (DX, VFD's, etc.):
1. Where equipment is provided with code numbers corresponding to alarm conditions, read and display the alarm code in the alarm indication line. Provide a dedicated page or table which explains the meaning of each code number.
2. Where equipment does not offer coded alarms, monitor general alarm contacts along with any other alarm conditions described herein and display alarm condition on graphic.

N. DOAS (dedicated outside air system) units: NA

O. VAV boxes (single duct air terminals):
1. Supply air CFM deviates from setpoint by 15% or more for 15 consecutive minutes.
2. High (120F) or low (50F) leaving air temperatures are detected.
3. Damper for any VAV box remains at >95% open for more than 30 consecutive minutes

P. Zone Dampers:
1. Damper remains at >95% open for more than 30 consecutive minutes.
2. Cooling or Heating PID output signal is 100% for more than 3 consecutive hours.

Q. Heat Recovery Wheels or Pipes: NA

R. For all utility controllers, register alarms under the following conditions:
   1. System has been set to Purge mode.
   2. System remains in Purge mode for more than 30 consecutive minutes.
   3. Fan remains at high speed for more than 30 consecutive minutes.

1.11 GRAPHICS AND SOFTWARE UPDATES

A. For new Controllers, the Design Intent is to remove old Network Engines, and provide new Engine and Control Graphics with the latest UI graphics package.

B. Plans recreated from old drawings show locations of existing buildings and major HVAC equipment. Prior to providing quote, contractor shall perform site walkthroughs to get familiar with existing equipment, controls, locations of sensors, sequences, graphics, etc.

C. Upgrade floor plans as required to reflect current conditions of walls and room numbers. For specialty areas such as kitchen, cafeteria, science labs, art rooms, etc., list the room type after the room number – for instance, Rm 325, Science Lab.

D. As part of the submittals process, provide a copy of the old graphics and controls points, with the new proposed graphics for engineer review. Contractor shall review existing graphics and update them. During submittal phase, Engineer will review submitted graphics and provide guidance. Allocate time for updating graphics as required.

1.12 MULTIZONE, VAV DX SYSTEMS

A. Time Schedule:
   1. Program On and Off times per Owner's instructions.

B. Definitions
   1. Air terminal units: VAV boxes.
   2. "Critical box": VAV box with highest cooling demand, regardless of damper position. Highest cooling demand may better be determined, for examples, by cooling PID output signal or percentage of design CFM being provided.

C. Ensure that provided sequences are coordinated with equipment manufacturer.

D. Fan Control:
   1. Cycle fan during unoccupied periods as required to maintain space temperature setpoints.
   2. System starts fan to run continuously during occupied periods.
   3. During occupied mode, modulate fan speed between minimum speed (adj.) and 100% to maintain duct static pressure setpoint. Install sensor at a location 2/3rd the distance to the end of the ducting system, but upstream of VAV boxes. Field coordinate with Engineer.
   4. If duct static pressure is above setpoint and fan is at minimum speed, modulate bypass damper to maintain preset static pressure in supply ductwork.
   5. If static pressure drops below setpoint, close bypass damper before increasing fan speed.
   6. Upon high static reading (above 3", adj), issue an alarm and shut down the unit.
   7. Signal alarm if fan fails to start as commanded.

E. Unoccupied Mode Enable/Disable: During unoccupied hours, enable unit to meet setpoints. Run unit for a minimum of 30 minutes or until setpoints are achieved.

F. Occupied Mode:
1. During start-up, enable unit in cooling mode if two monitored zone temperatures are above cooling setpoint.
2. Modulate fan speed to maintain duct static pressure setpoint.
3. Cycle cooling stages to maintain cold coil DAT setpoint (54F, adj.)
4. Dehumidification mode: If zone temperatures are satisfied, but return air RH rises above setpoint (60%, adj) for 20 minutes, reset DAT setpoint to 52F (adj). When RH drops below setpoint, resume normal operation.

G. Reset of Static Pressure Setpoints
1. Reset duct static pressure and AHU DAT to maintain space temperature and relative humidity setpoint conditions in the most energy efficient manner possible. Program a cascading sequence as follows:
   a. Monitor and poll VAV damper position to gauge cooling demand. If critical box % cooling demand (PID) is less than 95%, gradually reset (lower) duct static pressure setpoint as required to maintain Critical box demand at 95% or greater, while AHU leaving air temperature remains at Normal setpoint.
   b. As space cooling load decreases, duct static pressure setpoint eventually reaches minimum allowable, after which Critical box damper demand drops below 95% to avoid overcooling space.
   c. As cooling loads increase, reverse the above setpoint reset sequence.
2. Maximum and Maximum allowable discharge static setpoints are to be determined by testing, adjusting & balancing firm (TAB). Controls company must communicate and coordinate with TAB to obtain min and max allowable duct static pressure settings. Program those mix/max limits in to control system.
   a. Minimum allowable discharge static setpoint will be 0.5", or higher if recommended by TAB.
   b. Input from any box which has failed or lost communication shall be ignored.

H. Ventilation (OA) Sequence:
1. Dampers shall not be hardwired to open and close when units are enabled/disabled.
2. Associated exhaust fans shall be disabled and outside air dampers shall remain closed during unoccupied hours -including cool-down and nighttime reset operation.
3. Provide dedicated time schedule for OA dampers and exhaust fan that *can be* set independently of AHU time schedule. Obtain actual Occupancy schedule from Owner and open / close outside air damper per Owner's actual Occupancy schedule (and **not per AHU schedule**).
4. Provide return air CO2 sensor, and motorized OA and RA dampers for DCV. Modulate dampers to maintain CO2 setpoint. Damper position, and CO2 setpoint shall be operator adjustable.
5. Initial occupied period minimum OA positions shall be set at 50% (adj) of scheduled OA flow. Minimum damper position is determined by TAB Contractor such that building remains positively pressurized when building exhaust fans are on.
6. Coordinate required minimum and maximum OA damper positions with TAB. Modulate OA dampers such that unit brings in desired OA CFM at all fan speeds, i.e. OA damper will open more at minimum fan speed than at 100% fan speed.
7. Open OA damper fully when return air CO2 concentration exceeds 1100 ppm (adj).

a. If after 30 minutes of operation CO2 concentration has not fallen below 900 ppm, modulate return air damper 20% closed.
b. If after an additional 30 minutes of operation CO2 concentration has not fallen below 900 ppm, modulate return air damper 40% closed, and continue operation at that position until CO2 concentration has fallen below 900 ppm.
c. Modulate outside air dampers to minimum position when CO2 concentration falls to 900 ppm or lower; re-position return air dampers to fully open.
d. If CO2 concentration exceeds 1,400 ppm, or OA flow drops below minimum, system shall issue an alarm at the Central Operator's Station.

I. Exhaust fan interlocks: Coordinate software interlocks between exhaust fans and outside air dampers. Field coordinate for exhaust fan allocation to units.

J. Safeties:
1. Smoke Control: Smoke detector, located in return air, stops fan when products of combustion are detected in air stream. Stopping of fan automatically signals alarm.
2. High static pressure safety.
3. Freeze-stat safety.

K. Graphics Display: Indicate the following on display terminal for every unit:
1. Global Outside-air-temperature indication.
2. Global Outside-air-RH indication.
3. System graphic.
4. System occupied/unoccupied mode.
5. System on-off indication.
6. Fan command and status.
7. Fan speed and feedback, % of full speed.
8. Fan speed, Hz.
9. Cooling Stage 1 Compressor speed / % load indication.
10. Cooling Stage 2 Compressor speed / % load indication.
11. Discharge air temperature setpoint (downstream of cooling coils).
12. Discharge air temperature indication (downstream of cooling coils).
13. Duct static pressure setpoint.
14. Duct static pressure.
15. Bypass damper position.
16. Return temperature indication.
17. Return air relative humidity indication.
18. Return air CO2 level indication.
19. Outside-air damper position and feedback.
20. Return-air damper position and feedback.
21. Related EF fan status.
22. Outside air enthalpy and economizer status.
23. “Summary table” of all VAV boxes served by the AHU; indicate Box ID (number & room), space temperature, CO2, and call for cooling PID output”
a. Critical Zone VAV box identification, temperature, and damper position.
b. Critical Zone CO2 level, if applicable.

1.13 VARIABLE AIR VOLUME BOXES

A. Applies to new and existing VAV boxes.

B. Provide a Summary Page graphic screen for summarizing conditions of all associated VAV boxes, showing the following information: Box name, Space Temperature, Temperature Setpoint, Flow CFM actual, Flow CFM setpoint, Damper position, Discharge Air T, Heaters Stages, CO2 level (where indicated).

C. Sequences:
1. Enable unit according to time schedules of associated air handler.
2. Provide heating and cooling temperature setpoints with a minimum 5˚F deadband.
3. Allowable adjustable range settings shall be programmable only at the COS (and not at the zone thermostat).
4. Room sensor reports temperature. System modulates VAV damper to maintain temperature set point.
5. When room temperature is below cooling setpoint, damper shall be in minimum position. During unoccupied hours, minimum position shall be closed (adj).
6. When room temperature drops below heating setpoint, damper shall be set to a preset heating setpoint (50% minimum, adjustable initial setpoint). System modulates electric heater stages to maintain space temperature in heating mode.
7. For boxes with associated CO2 sensor:
   a. Monitor zone CO2 levels, for zones indicated on the drawings.
      1) If space CO2 level rises above setpoint, raise CFM setpoint in 10% increments each 10-minutes. However, at no point shall the CFM exceed the maximum design CFM.
      2) If CO2 level does not drop below setpoint, issue alarm. If situation does not get resolved, operator may continue to reduce setpoint. Contact engineer and contractor for recommendations if problems persist.
      3) Revert to normal operation when CO2 level returns to 50 ppm below setpoint.
8. Open VAV box damper to 100% when associated AHU is Off.
9. Operator Workstation: Display the following data:
   a. Room number(s) served.
   b. Name of room (e.g., Classroom 32; Media Center; Science Lab; etc.).
   c. Room temperature.
   d. Room temperature Base cooling and heating set points.
   e. Room temperature Effective cooling and heating set points.
   f. Air-damper position, percent open.
   g. Heater command.
      1) Staged heat: On/Off status, each stage.
      2) SCR heat: % output.
   h. Actual CFM.
   i. Design maximum, minimum, and heat mode CFMs.
   j. VAV box leaving air temperature.
   k. VAV box entering air temperature (this is not a separate, additional input point for VAV box controller; display the DAT of AHU serving box, along with name of the AHU, on VAV box graphic next to box air inlet duct).
   l. CO2 ppm and CO2 setpoints, where applicable. See drawings for sensor location.

1.14 SINGLE ZONE, VAV AHU

A. Time Schedule:
1. Program On and Off times per Owner’s instructions.

B. Fan Operation:
   1. Unoccupied periods: Cycle fan to maintain unoccupied period setback temperature.
   2. System starts fan to run continuously during occupied periods.
   3. Modulate fan speed between minimum speed (adj.) and 100% to maintain space temperature and RH setpoints.
   4. Signal alarm if fan fails to start as commanded.

C. Unoccupied Mode Enable/Disable: During unoccupied hours, enable unit to meet setpoints. Run unit for a minimum of 30 minutes or until setpoints are achieved.

D. Occupied Cooling Mode:
   1. During start-up, enable unit in cooling mode if zone temperature is above cooling setpoint.
   2. Cycle cooling stages to maintain cold coil DAT setpoint (54F, adj.)
   3. Dehumidification mode: If zone temperature is satisfied, but return air RH rises above setpoint (60%, adj) for 20 minutes, reset DAT setpoint to 52F (adj). When RH drops below setpoint, resume normal operation.

E. Reset of DX Coil Leaving Air Temperature Setpoint
   1. Reset AHU DAT to maintain space temperature setpoint in the most energy efficient manner possible. Program a cascading sequence as follows:
      a. As space cooling load decreases, fan speed will modulate down. Once fan is at minimum speed, and space temperature is below cooling setpoint, gradually reset AHU DAT higher in 0.5F degree increments per 10-minute time period.
      b. Coil leaving temperature setpoint shall never be allowed to exceed 58F (adj).
      c. As cooling load increases reverse the above setpoint reset sequence.

F. Heating Mode
   1. If space temperature is lower than the heating setpoint, fan should initially be at minimum speed:
      a. Enable heater and control it to maintain initial discharge air temperature setpoint of 85F (adj).
   2. If call for heat remains after 15 minutes, control heater SCR or staging as determined by control system PID calculation to attain heating setpoint. Continue to modulate / stage heater higher to attain up to a maximum 95F (adj.) if needed before increasing fan speed.
      a. Ensure CFM is adequate to keep heater proof of air flow safety and high temp safety cutout switches closed.
      b. At no time shall discharge air temperature setpoint be higher than 95F (adj.).
   3. Modulate / stage heater and fan down as required by system PID calculation.
   4. Disable heaters if space temperature rises above heating setpoint.
   5. A high discharge air temperature cut-out switch shall disable electric heaters and issue alarm at COS.

G. Ventilation Sequence
   1. Dampers shall not be hardwired to open and close when units are enabled/disabled.
   2. Associated exhaust fans shall be disabled and outside air dampers shall remain closed during unoccupied hours -including cool-down and nighttime reset operation.
   3. Provide dedicated time schedule for OA dampers and exhaust fan that *can be* set independently of AHU time schedule. Obtain actual Occupancy schedule from Owner

and open / close outside air damper per Owner's actual Occupancy schedule (and **not per AHU schedule**).

4. Provide return air CO2 sensor, and motorized OA and RA dampers for DCV. Modulate dampers to maintain CO2 setpoint. Damper position, and CO2 setpoint shall be operator adjustable.
   a. For Kitchen AHU, OA dampers shall remain to scheduled open position based on ventilation time schedule. CO2 based DCV is not required.
5. Initial occupied period minimum OA positions shall be set at 50% (adj) of scheduled OA flow. Minimum damper position is determined by TAB Contractor such that building remains positively pressurized when building exhaust fans are on.
6. Coordinate required minimum and maximum OA damper positions with TAB. Modulate OA dampers such that unit brings in desired OA CFM at all fan speeds, i.e. OA damper will open more at minimum fan speed than at 100% fan speed.
7. Open OA damper fully when return air CO2 concentration exceeds 1100 ppm (adj).
   a. If after 30 minutes of operation CO2 concentration has not fallen below 900 ppm, modulate return air damper 20% closed.
   b. If after an additional 30 minutes of operation CO2 concentration has not fallen below 900 ppm, modulate return air damper 40% closed, and continue operation at that position until CO2 concentration has fallen below 900 ppm.
   c. Modulate outside air dampers to minimum position when CO2 concentration falls to 900 ppm or lower; re-position return air dampers to fully open.
   d. If CO2 concentration exceeds 1,400 ppm, or OA flow drops below minimum, system shall issue an alarm at the Central Operator's Station.

H. Exhaust fan interlocks: Coordinate software interlocks between exhaust fans and outside air dampers. Field coordinate for exhaust fan allocation to units.

I. Safeties:
1. Smoke Control: Smoke detector, located in return air, stops fan when products of combustion are detected in air stream. Stopping of fan automatically signals alarm.
2. High temperature safety.
3. Freeze-stat safety.

J. Operator Station Display: Indicate the following on operator workstation display terminal:
1. Global Outside-air-temperature indication.
2. Global Outside-air-RH indication.
3. System graphic.
4. System occupied/unoccupied mode.
5. System on-off indication.
6. Fan command and status.
7. Fan speed and feedback, % of full speed.
8. Fan speed, Hz.
9. Cooling Stage 1 Compressor speed / % load indication.
10. Cooling Stage 2 Compressor speed / % load indication.
11. Discharge air temperature setpoint (downstream of cooling coils).
12. Heater Stage Staging command / % load indication.
13. Discharge air temperature indication (downstream of heater).
14. Discharge air temperature setpoint (downstream of heater).
15. Discharge air temperature indication (downstream of cooling coils).
16. Space temperature setpoint and indication.
17. Space air relative humidity setpoint and indication.

18. Space air CO2 level setpoint and indication.
19. Outside-air damper position and feedback.
20. Return-air damper position and feedback.
21. Related EF fan status.
22. Outside air enthalpy and economizer status.

1.15 FCU SCHEDULED CONTROL SEQUENCES (DX FCU and ACCU)

A. Applicable to split systems, mini-splits, including FCUs and associated ACCUs. Provide dedicated BAS controllers as needed. Coordinate with equipment on site.

B. Sequences
1. Unit Start/Stop: 24/7 operation, unless Owner indicates otherwise.
2. Monitor unit status and space temperature.
3. Heating and Ventilation Modes: Not applicable.

C. Operator Workstation: Display the following data:
1. System graphic.
2. Unit commanded state.
3. Space Temperature.
4. Space Temperature Cooling setpoint.

1.16 BUILDING EXHAUST FAN SCHEDULED CONTROL SEQUENCES

A. Sequence:
1. Enable/Disable or turn fans On/Off, as applicable and indicated in drawings, according to programmed operating schedule.
2. Set up exhaust fan operating schedules for each type of exhaust fan (e.g. all fume hoods, all restrooms, all acid cabinets) and for each floor, independent of time schedules of associated RTUs or AHUs.
3. Coordinate time schedules with Owner, and with HVAC schedules for restroom exhaust fans such that fans are not enabled prior to the typical scheduled Open schedule for rooftop unit OA dampers, and are disabled at time equal to the typical scheduled Close time for AHU/RTU OA dampers

B. Manual Override: Control may be manually overridden at the controller and at the COS. Control will remain in “Override” position for a pre-programmed time period (1 hour, adj).

C. Interlocks:
1. Hardware Interlocks: Controls shall not bypass any safeties or interlocks associated with fire protection shutdown.
2. Software Interlocks: Provide all hardware necessary to achieve software interlocks required for proper system operation. Coordinate with mechanical and electrical contractors.

D. <u>Two speed exhaust fans at Science Labs:</u>
1. Fans have two-speed motors, and shall operate either in NORMAL ventilation mode at low speed, or under PURGE ventilation mode at high speed.

2. While BAS shall enable / disable fans according to occupancy schedule, fans shall be locally turned on / off by the teacher manually.
3. NORMAL Mode Sequence: Enable/disable EFs in NORMAL mode according to occupancy schedule. Occupant shall start/stop fan via switch at Utility Controller, and fan is to operate at low speed.
4. PURGE Mode Sequence: EFs will be started in PURGE mode when manual pushbutton PURGE switch is activated, and fans are to operate at high speed. Fans shall remain in PURGE mode for a pre-programmed time period (10 minutes, adjustable).
5. Overrides and time schedule shall be programmed per sequences above.

E. Pass-through Fume Hood Exhaust Fans
1. Design Intent: While DDC shall enable / disable fans according to occupancy schedule, fans shall (operate) be turned on / off by a manual switch at fume hood.

F. Kitchen Exhaust Fan and Make-Up Air Fan: Retain existing sequences and interlocks.

G. All other exhaust fans: Fans operate continuously or are Enabled/Disabled via time schedules during occupied mode.

H. Operator Workstation: Display the following data:
1. System graphic.
2. System occupied/unoccupied mode.
3. Fan on-off command or Off/Enable command, as applicable.
4. Fan speed (indicate Hi or Lo), as applicable.
5. Fan status.
6. Utility Controller Purge Status (via direct reading of purge relay contacts)

1.17 DOMESTIC WATER HEATER

A. See drawings for water heater locations. The controls contractor is responsible for complete installation, including furnishing and installing control relays if not integral to water heater or circulating pump. Coordinate with Div. 26 for 480V contactor.

B. Provide time schedules and optimal start/stop function for water heaters.

C. Operator Workstation: Display the following data:
1. System graphic.
2. Water Heater Off / Enable.
3. Water Heater Pump Off / Enable.
4. Hot water temperature sensor.

1.18 ELECTRIC METER MONITORING

Applies to Applies to Service Entrance.

A. Prior to bidding, coordinate with site conditions to ascertain communications protocol interface, if available. Provide meters, CTs, and all accessories necessary for an operational system.

B. Operator Station Display: Indicate the following on operator workstation display terminal:
1. Demand (list to 0 decimal places)

a. Present kW demand.
b. Peak kW demand in current monthly billing cycle.
c. Present KVA demand.
d. Peak KVA demand in current monthly billing cycle.

2. kWh (list to 0 decimal places)
   a. Cumulative for current day.
   b. Current month to date.
   c. Cumulative for previous month.
   d. Cumulative year to date.
3. Power Factor (list to 2 decimal places)
4. Amps (list to 0 decimal places)
   a. Amps, all 3 legs.
   b. Amps, average.
   c. Neutral amps.
5. Voltage (list to 0 decimal places)
   a. Present L-L voltage, all 3 legs.

C. Trend and store the following parameters every 15 minutes, with minimum 5 days data storage:
1. KVA demand.
2. kW demand.
3. Power Factor.
4. Amps, each leg.

1.19 OTHER SYSTEMS

A. Coordinate with existing BAS to determine exact scope for new controls work related to all other miscellaneous systems. Ensure that new BAS will replace existing controls in their entirety.

1.20 OTHER SEQUENCES

A. Operator Overrides: System shall allow operator to enable / disable unit and / or control / adjust all setpoints from COS.

B. Graphics pages must have units listed beside parameter values (e.g. ˚F, ppm, % Open, psi, etc.)

C. When parameters are in manual or test modes, graphics shall indicate that they are in test mode.

D. Provide up to 12 hours of programming to account for additional control sequences and fine-tuning above sequences, during the project. Perform site visits prior to bidding.
1. The design intent is to operate HVAC systems in VAV mode, while maintaining constant OA flow when fans change speed. The engineer or CXA may request additional fine tuning of sequences and coordination with TAB contractor to balance OA and RA damper positions to maintain constant OA flow.

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty.

1. Include pressure drop, based on manufacturer's test data, for the following:

a. Thermostatic expansion valves.
b. Solenoid valves.
c. Hot-gas bypass valves.
d. Filter dryers.
e. Strainers.
f. Pressure-regulating valves.

B. Shop Drawings:

1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
3. Show interface and spatial relationships between piping and equipment.
4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig.
2. Suction Lines for Heat-Pump Applications: 225 psig.
3. Hot-Gas and Liquid Lines: 225 psig.

B. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

C. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8/A5.8M.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.

3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Reverse-flow option (for heat-pump applications).
7. End Connections: Socket, flare, or threaded union.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 24-V ac coil.
7. End Connections: Socket.
8. Throttling Range: Maximum 5 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.

5. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:
1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Permanent Filter Dryers: Comply with AHRI 730.
1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina, charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

L. Receivers: Comply with AHRI 495.

1. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

M. Liquid Accumulators: Comply with AHRI 495.
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arkema Inc.
2. DuPont Fluorochemicals Div.
3. Genetron Refrigerants; Honeywell International Inc.
4. Mexichem Fluor Inc.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

2.5 REFRIGERANT PIPING SUPPORT EXTERIOR TO BUILDING

A. Exterior: Pre-manufactured strut supports; 3/8” stainless steel threaded rods holding 7” long aluminum cross-strut, stainless steel bolts, 3” to 6” adjustable height, molded 33% fiberglass reinforced nylon support base; UV stabilized. MAPA Products, type MS-2 or MS-3.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.3 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel 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 to 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 D10.12M/D10.12.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 232923 - VARIABLE FREQUENCY MOTOR 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. This Section includes solid-state, PWM, VFDs for speed control of three-phase, squirrel-cage induction motors.

B. Related Sections include the following:
   1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
   2. Division 26 Section "Transient Voltage Suppression" for low-voltage power, control, and communication surge suppressors.

1.3 DEFINITIONS

A. BAS: Building Automation System.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFD: Variable frequency drive.

1.4 REFERENCES

A. ANSI/NEMA ICS 6 – Enclosures for industrial control systems.

B. ANSI/UL 198C – High intensity capacity fuses; current limiting types.

C. NEMA ICS 2 – Industrial control devices, controllers, and assemblies.

D. NEMA KS 1 – Enclosed switches.

E. NEMA PB 1.1 – Instructions for safe installation, operation, and maintenance of panelboards rated 600 volts or less.

1.5 SUBMITTALS

A. Product Data: For each type of VFD, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings: For each VFD.
   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. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current ratings of integrated unit.

   2. Wiring Diagrams: Power, signal, and control wiring for VFD. Provide schematic wiring diagram for each type of VFD.

C. Manufacturer's field service report.

D. Operation and Maintenance Data: For VFDs, all installed devices, and components to include in emergency, operation, and maintenance manuals. Include routine maintenance requirements for VFDs and all installed components

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer.

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. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, minimum clearances between VFDs, and adjacent surfaces and other items. Comply with indicated dimensions and clearances.

D. Comply with NFPA 70.

E. UL listed drive and UL-508 listed bypass/inverter assembly.

1.7 WARRANTY

A. Written warranty, signed by manufacturer. Manufacturer's standard form in which manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period. Manufacturer will provide all labor required for replacement of materials, equipment, controls, and any other portion of complete assembly, as required. A factory-trained employee of manufacturer shall perform warranty work.
   1. Warranty Period for VFD’s: Manufacturer's standard, but not less than three years from date of Substantial Completion.

2. Warranty period will commence from the date of manufacturer's startup.

B. For the duration of the warranty, local manufacturer's representative must provide a response time of no more than 24 hours. Any failed VFD must be put back into automatic operation within this time period. Mere acknowledgement of a problem does not constitute an acceptable response.

1.8 SPARE PARTS

A. Spare Fuses: Furnish three spare fuses for each type and rating installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Danfoss.
2. Yaskawa.
3. Other manufacturers may be accepted only with prior approval of Engineer, and only if they meet all requirements of this specification. Provide request for substitution a minimum of 7 days prior to submission of bid.

B. Specific models proposed must have a continuous and proven track record of no less than 3 years.

2.2 VARIABLE FREQUENCY DRIVES

A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, premium-efficiency induction motor by adjusting output voltage and frequency.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:

1. Input ac voltage tolerance of 380 to 480 V, plus or minus 10 percent.
2. Input frequency tolerance of 60 Hz, plus or minus 6 percent.
3. Capable of driving full load, under the following conditions, without derating:

a. Ambient Temperature: 0 to 40 deg C.
b. Humidity: Less than 90 percent (non-condensing).
c. Altitude: 3300 feet (1000 m).

4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 97 percent.
6. Overload Capability: 1.10 times the base load current for 60 seconds at 40˚C; 2.0 times the base load current for 3 seconds at 40˚C.
7. Starting Torque: 100 percent of rated torque or as indicated.
8. Speed Regulation: Plus or minus 1 percent.
9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
10. Continuous output current rating shall be no less than 100% of NEC motor amperage ratings.
11. Overload current capability of power cube at 40˚C shall equal or exceed 200% of NEC motor amperage values for instantaneous trip, and 110% of NEC amperage for a minimum of sixty seconds, without damage to power cube.
12. Minimum 5% input impedance line reactor; comply with EN61000-3-2, or minimum 3% DC link reactor (also called inductive choke) connected to the DC bus between the rectifier and the PWM inverter.

E. Power Quality Issues

1. VFD must be capable of operating satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic distortion and commutation notches up to 36,500 volt-microseconds, and when other VFDs are operating from the same bus.
2. VFD shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (the consumer–utility interface or primary side of the main distribution transformer).
3. The system shall not produce spikes on the incoming line.
4. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.
5. Provide input line noise suppression with MOV's (metal oxide varistors) and snubber circuits to allow for operation on typical industrial or commercial power distribution systems. MOV's shall be provided across incoming line terminals and transistors to protect inverter from voltage surges and spikes.
6. The VFD shall not induce excessive power losses in motors. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS current for pure sine wave operation.
7. VFD must be capable of operating a motor satisfactorily with up to 300 feet of wiring between VFD and motor.

F. Diodes: Bridge rated for 1600 volts.

G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.

5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

H. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Snubber networks to protect against malfunction due to system voltage transients.
3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
4. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor overload.
11. Motor over-temperature fault.
12. Heat sink over temperature (Max. operating ambient: 104 degrees F)
13. Protect solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent over-current trip due to momentary overload conditions.

I. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto-speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

K. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).

2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFD with the following:

1. Provide communications devices as necessary to allow for connectivity to major automation systems.

2. VFD shall be provided with protocol information specific to Owner's BAS control manufacturer and shall be pre-configured at the factory to provide automatic communications, without the need for field programming, via a single twisted pair wire.

   a. The VFD shall allow the DDC system to control the drive's digital and analog outputs and monitor all drive digital and analog inputs via the serial interface.
   b. VFD is to support BACNet, LonWorks, and Modbus RTU.
   c. Serial communications capabilities include, but are not limited to: run/stop control, speed set adjustment, proportional/integral or PID control adjustments, current limit and acceleration/deceleration time adjustments. The drive shall also have the capability of allowing the DDC system to monitor the following feedback signals: process variable, output speed/frequency, current, torque, power (KW), operating hours, kilowatt hours; relay outputs, and diagnostic warning and fault information.

3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
   a. 0 to 10-V dc.
   b. 0-20 or 4-20 mA.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.
   e. RS485.
   f. Keypad display for local hand operation.

4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set-point speed reached.
   c. Fault and warning indication (over-temperature or over-current).
   d. PID high or low speed limits reached.

Q. Manual Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

R. Isolating Switch: Non-load-break switch arranged to isolate VFD and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

S. Bypass Controller:
1. NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
2. Bypass section is to be located in a metal enclosure separate from the drive section, and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode without exposing personnel to any electrical voltage. VFD shall have inverter input power disconnect with door interlocked handle (lock out type) arranged to isolate VFD and permit safe troubleshooting & testing of inverter in when energized and/or de-energized, while motor is operating in bypass mode.
3. Manual bypass shall contain:
   a. A molded case circuit breaker or non-fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
   b. A thermal overload to provide protection of motor in the bypass mode.
   c. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation—“inverter” or “bypass”) in response to a signal from the thermal overload and/or external safety circuits.
   d. Line voltage to 120/1 volt transformers, fused per NEC, to provide power to bypass control circuits. Transformer shall be sized to include additional 20VA capacity for use by EMS contractor. DC and/or solid-state bypass sources are not acceptable.

T. Non-fused input disconnect switch.

U. Where indicated, provide accessories for “Contactor Motor Selection with Bypass” that will allow the DDC system to remotely switch lead-lag motors.

2.3 ENCLOSURES

A. NEMA 4XSS for any VFD located outdoors.

B. NEMA 12, for all other VFDs located in unconditioned space (indoors).

C. NEMA 1, for all other VFDs located in conditioned space (indoors).

D. Metal inverter enclosure. Plastic and/or fiberglass enclosures are not acceptable.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFDs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFD mounting surface.

B. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

C. Do not install incoming AC lines in same conduit as feeder lines to motor.

D. Do not install wiring runs between VFD and motor longer than recommended by manufacturer.

3.4 IDENTIFICATION

A. Identify VFDs, components, and control wiring according to Division 16 Section "Basic Electrical Materials and Methods"

3.5 CONNECTIONS

A. Ground equipment.

B. 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.

3.6 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: Perform the following field quality-control testing:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. 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.

C. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFDs, and perform startup service.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

D. Upon successful completion of testing, submit written certification that drives are operating in accordance with Contract Documents, and within design operating limits of equipment. Notify Owner; include set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

A. Clean VFDs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 DEMONSTRATION

A. Provide services of manufacturer trained employee(s) for minimum of three hours training. Demonstrate operation of controllers in the automatic, manual, and bypass modes.

END OF SECTION 23 29 23

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, spiral-seam, round ducts and fittings.
   3. Double-wall, round and flat-oval spiral-seam ducts and formed fittings.
   4. Sheet metal materials.
   5. Duct liner.
   6. Sealants and gaskets.
   7. Hangers and supports.

B. Related Sections:
   1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233300 "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"

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
   3. Fire-Stopping Materials.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Penetrations of smoke barriers and fire-rated construction.
   6. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

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."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. Round, Spiral Lock-Seam Ducts.

B. 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:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Sheet Metal Connectors, Inc.
      e. Spiral Manufacturing Co., Inc.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. Duct Joints:
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 72 Inchesin Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
      a. Manufacturers:
         1) Ductmate Industries, Inc.
         2) Lindab Inc.

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
   2. Round Mitered Elbows with Aerofoil Vanes: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
      a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
      b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.

   3. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
   4. Round Elbows 8 Inchesand Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
   5. Round Elbows 9 through 14 Inchesin Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate

nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

6. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
7. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
9. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 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:
      a. Owens Corning’s Aeroflex Plus Duct Liner or Equal.

   2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
      a. Maximum Thermal Conductivity:
      b. Thickness: 1 inch for sound attenuation, and R8 for thermal insulation.
      c. Thermal Conductivity (k-Value): 0.26 at 75 deg Fmean temperature.

d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84.
e. Water-Based Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
f. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
    1) Tensile Strength: Indefinitely sustain a 50-lb-tensile, dead-load test perpendicular to duct wall.
    2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
    3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

3. 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.

2.5 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. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant 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."

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, 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. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant 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."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 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, "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 Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 FIRE-STOPPING

A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant, one-part elastomeric sealant, formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Products: Subject to compliance with requirements, products that may be incorporated in the Work are limited to, the following:
   1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
   2. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
   3. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.

C. Seams and laps arranged on top of duct.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval 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, 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.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. 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 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. 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.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   1. Fan discharges.
   2. Intervals of lined duct preceding unlined duct.
   3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", and as defined below.
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. All Ducts U.N.O: Seal Class A.
   3. Unconditioned Space, Return-Air Ducts: Seal Class B.
   4. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: 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.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 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 9 Sections.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. **Comply with requirements for Leakage Class A for sealing all ducts.** Refer to SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Supply, Return, Exhaust, Outdoor Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      b. Engineer will randomly designate two supply duct systems for testing in accordance with Section 4 of SMACNA HVAC Air Duct Leakage Test Manual, current edition. If leakage test results exceed SMACNA allowable leakage rates, then additional two systems shall be tested. Supply duct test section shall include main trunk line from the mechanical room to the farthest VAV box. For systems without VAV boxes, main trunk shall be determined on site

   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days' advance notice for testing.

C. 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.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 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 Section 233300 "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. Replace 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.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

A. Supply Ducts:
   1. Ducts Connected to Fan Coil Units, and Terminal Units:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A
   2. Ducts Connected to Constant-Volume Air-Handling Units:
      a. Pressure Class: Positive 3-inch wg
      b. Minimum SMACNA Seal Class: A
   3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
      a. Pressure Class: Positive 4-inch wg.
      b. Minimum SMACNA Seal Class: A

B. Return Ducts:
   1. Ducts Connected to Fan Coil Units, and Terminal Units
      a. Pressure Class: Positive or negative 2-inch wg
      b. Minimum SMACNA Seal Class: B.
   2. Ducts Connected to Air-Handling Units
      a. Pressure Class: Positive or negative 3-inch wg
      b. Minimum SMACNA Seal Class: B

C. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg
      b. Minimum SMACNA Seal Class: A

D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to AHUs, Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units
      a. Pressure Class: Positive or negative 2-inch wg
      b. Minimum SMACNA Seal Class: A

E. Double-Wall Duct Interstitial Insulation, where specifically noted on the drawings:
   1. Supply Air Ducts: 2 inches thick, unless noted otherwise on drawings.

F. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Double Skin vaned elbows. See drawings.
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
      a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
         1) Radius-to Diameter Ratio: 1.5.
      b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
      c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.
   2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
      a. Velocity 1000 fpm or Lower: 90-degree tap.
      b. Velocity 1000 to 1500 fpm: Conical tap.
      c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Flange connectors.
7. Turning vanes.
8. Remote damper operators.
9. Duct-mounted access doors.
10. Flexible connectors.
11. Flexible ducts.
12. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

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.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL 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 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.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.

B. Description: Gravity balanced. Blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner, steel ball bearings, and axles.

C. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

D. Blades: Multiple single-piece blades, 0.050-inch-thick aluminum sheet with sealed edges.

E. Blade Action: Parallel.

F. Blade Seals: Neoprene, mechanically locked.

G. Blade Axles:

1. Material: Galvanized steel.

H. Tie Bars and Brackets: Galvanized steel.

I. Return Spring: Adjustable tension.

J. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators, where noted.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.

a. Sleeve Thickness: 20 gage minimum.
b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Stainless steel.
8. Screen Type: Bird.
9. 90-degree stops.

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. Flexmaster U.S.A., Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.
4. Frames:

   a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
   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 thick.

6. Blade Axles: Galvanized steel.

7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. McGill AirFlow LLC.
   b. Nailor Industries Inc.
   c. Pottorff.
   d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with 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. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

6. Blade Axles: Galvanized steel.

7. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pottorff.
    b. Ruskin Company.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:

    a. Hat shaped.
    b. 0.094-inch-thick, galvanized sheet steel.
    c. Mitered and welded corners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized, roll-formed steel, 0.064 inch thick.

7. Blade Axles: Galvanized steel.

8. Blade Seals: Neoprene.
9. Tie Bars and Brackets: Galvanized steel.
10. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Pottorff.
   b. Ruskin Company.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
   d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

7. Blade Axles: Galvanized steel.

8. Blade Seals: Neoprene.
9. Tie Bars and Brackets: Aluminum.
10. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 1-inch 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.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch 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. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.
4. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. 0.094-inch-thick, galvanized sheet steel.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings 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, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.7 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ.
3. Ward Industries, Inc.

B. Description: Factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. METALAIRE, Inc.
3. SEMCO Incorporated.
4. Ward Industries, 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.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

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: Double wall.

2.9 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff.
2. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Cover-Plate Material: Stainless steel.

2.10 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. Greenheck Fan Corporation.
3. Pottorff.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "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 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.

2.11 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. Ward Industries, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-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..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

2.12 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Flexmaster U.S.A., Inc.
2. Thermaflex

A. Where acoustical flexible duct is shown on drawings, provide Flexmaster Type 8M (or Thermaflex M-KE) UL 181 Class I Air Duct or equal.

B. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel. The fabric shall be mechanically locked to the steel helix without the use of adhesives or chemicals.

C. The internal working pressure rating shall be at least 6" w.g. positive and 4" w.g. negative through 16" diameter, and 1" w.g. negative for 18" and 20" diameters, with a bursting pressure of at least 2 ½ time the working pressure.

D. The duct shall be rated for a velocity of at lease 4000 feet per minute.

E. The duct must be suitable for continuous operation at a temperature range of -20° F to +250° F.

F. Factory insulate the flexible duct with fiberglass insulation. The R-value shall be at least 8 at a mean temperature of 75° F.

G. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure.

H. Sound attenuation Properties: Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties, shall be as follows:

Octave Band	**2**	**3**	**4**	**5**	**6**	**7**
Hz.	125	250	500	1000	2000	4000
6" diameter	7	31	40	38	40	27
8" diameter	13	29	36	35	38	22
12" diameter	21	28	29	33	26	12

I. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.13 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. Install backdraft dampers (control dampers for fans 2,000CFM and larger) at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

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 access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. 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.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly, and for fan powered boxes with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect flexible ducts to metal ducts with stainless steel draw bands.

P. Install duct test holes where required for testing and balancing purposes.

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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes replacement of air-cooled condensing units. Match indoor and outdoor equipment, including refrigerant, number and type of compressors, circuits, stages, and circuiting and coordination with existing evaporators, and refrigerant line sizes. Provide all refrigerant specialties and reinsulate lines.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design:
   1. Design ACCU supports to comply with **wind** performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Prior to bidding Manufacturer / Supplier shall verify existing equipment and materials that are deemed to be retained and reused. Verify condition and adequacy of AHUs, DX cooling coils, refrigerant piping routing, sizing, circuiting, etc., and recommend changes that may be required such that the new systems operate optimally and flawlessly.

B. Wind-Restraint Performance rated for basic Wind Speed: Rated for project location.

1.4 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For compressor and condenser units indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for selecting **wind restraints**.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members to which compressor and condenser units will be attached.
   2. Liquid and vapor pipe sizes.
   3. Refrigerant specialties.
   4. Piping including connections, oil traps, and double risers.
   5. Compressors.
   6. Evaporators.

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Wind Storm Certification, International Building Code and TDI Compliance Statement and shop drawings from a licensed PE for IBC and TDI.
   1. Licensed Professional Engineer shall certify that the listed items are designed for and will withstand wind speed for the location of the project, per the relevant edition of International Building Code, ASCE Std 7, Texas Department of Insurance requirements:
   2. Sealed shop drawings showing installation instructions and attachment of equipment. Include quantity and type of restraining brackets/clips, screws, spacing, etc.
      a. Attachment of equipment to pad.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label water-cooled compressor and condenser units to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."

B. Coordinate location of piping and electrical rough-ins.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Compressor failure.
      b. Condenser coil leak.
   2. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
   3. Warranty Period (Components Other Than Compressor): One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trane (Design Basis)
   2. Daikin
   3. Johnson Controls / York
   4. Others with prior approval

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic scroll or semi hermetic, rotary scroll compressor designed for service with crankcase sight glass, crankcase heater, and back seating service access valves on suction and discharge ports.
   1. Motor: Single or Two speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
   2. Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
   3. Accumulator: Suction tube.
   4. Digital scroll compressor on lead circuit for units where existing units had digital scroll compressors.

D. Refrigerant: R-454B or R-32.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, or aluminum microchannel coils with a 3-year warranty; including subcooling circuit and backseating liquid-line service access valve, and brass service valves with service ports, with separate and independent refrigeration circuit as scheduled. See schedules for number of circuits and compressors. Include liquid accumulator or suction line accumulator. Factory test coils at 650 psig, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen. E-Coated for added corrosion protection.

F. Condenser Fans: Propeller-type vertical discharge; directly driven. Include the following:
1. Permanently lubricated ball-bearing motors.
2. Separate motor for each fan.
3. Motors with thermal-overload cutouts.
4. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:
1. Manual reset, high-pressure cutout switches.
2. Automatic reset, low-pressure cutout switches.
3. Low oil pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. 3-leg, compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.

H. Accessories:
1. Coordinate with specified building automation system. Provide controls interface to control condensing unit and evaporator fan.
2. Low Ambient Controller: Head pressure control damper assembly to permit operation down to 0 deg F with time-delay relay to bypass low-pressure switch.
3. Part-winding-start timing relay, circuit breakers, and contactors.
4. Automatic-reset timer to prevent rapid cycling of compressor.
5. Thermostatic expansion valve to match with Evaporator Coil.
6. Evaporator defrost controller.
7. Liquid line solenoid valves, multiple compressors, factory/field installed accumulators to accomplish stages of unloading.
8. Site glass, filter-dryer.
9. 30% Bleed Thermostatic expansion valve.
10. See drawing schedules.

I. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:
1. Steel, galvanized or zinc coated, for exposed casing surfaces, treated and finished with manufacturer's standard paint coating.
2. Lifting lugs to facilitate rigging of units.
3. Gasketed control panel door.
4. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
5. Condenser coil hail guard to protect coil from physical damage.
6. E-coat.

7. Wind Restraints: Metal brackets compatible with the unit casing, painted to match unit, used to anchor unit to the pad, and designed for loads at Project site.

J. Specifications Related to Design Basis ACCUs: Ensure that ACCUs match existing AHUs. Provide digital scroll lead compressors where existing ACCUs had had digital scroll compressors.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 206/110, ARI 306/110.

B. Energy Efficiency: Equal to or greater than the higher of the scheduled efficiency or that prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated.

B. Equipment Mounting:
   1. Install compressor and condenser units on cast-in-place concrete equipment bases.
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
   3. Provide anchoring devices to meet windstorm certification.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

B. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

C. Arrange for insulation of entire evaporator body, all suction lines, and all other surfaces where condensation might occur, both internal and external to unit cabinet, whether such items are factory-insulated or not, and whether provided by manufacturer or installing contractor. Non-insulated cold surfaces will not be accepted.

D. Ground equipment.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Electrical Connections: Comply with requirements in Division 16 Sections for power wiring, switches, and motor controls.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
   2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service for split system.
1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
   a. Inspect for physical damage to unit casing.
   b. Verify that access doors move freely and are weathertight.
   c. Clean units and inspect for construction debris.
   d. Verify that all bolts and screws are tight.
   e. Adjust vibration isolation and flexible connections.
   f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

END OF SECTION 236200

SECTION 237313 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes air-handling units with direct expansion cooling coils, in horizontal and vertical configurations, for indoor installations on concrete pads.

1.3 SUBMITTALS

A. Product Data: For each air-handling unit indicated.
   1. Unit dimensions and weight.
   2. Cabinet material, metal thickness, finishes, insulation, and accessories.
   3. Fans:
      a. AMCA 210 certified fan-performance curves with system operating conditions indicated.
      b. AMCA 301 certified fan-sound power ratings.
      c. Fan construction and accessories.
      d. Motor ratings, electrical characteristics, and motor accessories.
   4. Certified coil-performance ratings with system operating conditions indicated.
   5. Dampers, including housings, linkages, and operators.
   6. Filters with performance characteristics.

B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
   2. Support location, type, and weight.
   3. Field measurements.

C. Source quality-control reports.

D. Field quality-control reports.

E. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. AHRI Certification: Air-handling units and their components shall be factory tested according to AHRI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by AHRI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Equipment shall be UL certified and listed and classified by ETL.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate base size with condensate drain connection opening and requirements for condensate drain trap size.

C. Coordinate side of coil connections and access doors. Coordinate exact dimensions of custom openings for supply, return and fresh air. Coordinate dimensional limitations.

D. Since spatial constraints are an important consideration, coordinate site conditions, space availability for equipment, maintenance and NEC clearances, etc., prior to submitting bids.

E. Electric duct heater location (if applicable) shall be coordinated with existing ductwork configuration on site. Ensure that adequate clearances and straight sections are maintained for proper performance and maintenance.

1.6 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by Contractor and signed by manufacturer, agreeing to replace components that fail in materials and workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

1. Warranty Period: One year parts and labor from date of Substantial Completion. Labor warranty may be provided by manufacturer or installing contractor.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set for each air-handling unit.
   2. Fan Belts: One set for each air-handling unit fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Daikin Applied
   2. York International Corporation.
   3. Trane

2.2 GENERAL REQUIREMENTS

A. Manufacturer shall clearly define any exceptions made to plans and specifications. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

B. Carefully coordinate with Electrical, Mechanical, and Controls Contractors for items of work that required close integration.

C. Units shall be delivered prewired, bearing an approved label with all of the necessary identification marks, electrical data, and any necessary cautions as required by the National Electrical Code.

D. The entire unit shall be covered with a protective covering from time of shipment at factory until installed with structure protecting indoor air handling units. If at any time the protective covering is removed before installation, the equipment shall be thoroughly cleaned, internally and externally.

E. Unit shall be factory assembled central station air handler with a fan, motor and drive assembly, refrigerant coils, access section, combination filter-mixing box section, control dampers and accessories, as indicated on schedules and details.

F. All unit sections shall be supplied with longitudinal 16-gage or higher G90 galvanized steel structural perimeter base rails to serve as housekeeping rails when unit is installed. The manufacturer at the factory shall install base rails. Perimeter lifting brackets shall be provided on each section. Slinging of units in place of lifting brackets is not acceptable.

G. Units shall ship in the fewest number of sections to meet project requirements. All section shall be individually flanged and gasketed to allow easy assembly and disassembly.

2.3 UNIT CASINGS

A. Horizontal, Evaporator-Fan Components: An assembly including cabinet, filter, chassis, coil, drain pan, fan, and motor in blow-through configuration with direct-expansion cooling coil, and electric heating coil where noted.

B. Unit shall be constructed not to deflect more than L/240 at any point on the exterior liner, maximum of 5 inches of positive or 6 inches of negative static pressure. Air leakage shall not exceed 0.5 cfm per square foot of casing surface area at specified casing pressure up to a maximum of +5" w.c. in positive pressure sections and -6" w.c. in negative pressure sections.

C. Cabinet: G90 galvanized steel, thickness as required to meet deflection limits. Cabinet walls shall have insulated panels, fabricated to allow removal for access to internal parts and components. Units shall be designed and equipped for installation indoors.

D. Chassis: G90 galvanized steel, thickness as required to meet deflection limits. Removable panels for servicing, and insulation on back of panel.
   1. Insulation: Standard insulation or minimum 2", whichever is greater.

E. Condensate Drain Pans: Formed sections of **stainless-steel** sheet complying with requirements in ASHRAE 62.
   1. Drain Connections: One end of pan. Coordinate with drawing.
   2. Units with stacked coils shall have a stainless steel intermediate drain pan with copper drop tubes to main pan to collect condensate from top coil.

F. Base Rail: Unit shall have a minimum 6" tall continuous base rail bolted or welded to the unit frame. Mounting feet are not acceptable.

2.4 FAN SECTION

A. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Special Motor Features: Variable speed electronically commutated direct drive motor design with internal motor overloads.
   2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   3. Enclosure Type: TEFC, fan cooled.
   4. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
   6. Disconnect switches by Div. 26.

2.5 MOTORS

A. General: Refer to Division 23 Section for general requirements for motors.

B. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.

C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range.

D. Totally Enclosed Fan Cooled (TEFC), premium efficiency (E+3) type, NEMA Design B, inverter rated for Variable Speed Drive application, of size and electrical characteristics as shown on equipment schedule.

E. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

F. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

G. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B mounted on adjustable base.

H. Bearings: The following features are required:
1. Ball or roller bearings with inner and outer shaft seals.
2. Grease lubricated. Provide grease lines for motor and shaft lubrication, extended to the to a common mounting on access side of fan.
3. Designed to resist thrust loading where belt or other drives produce lateral or axial thrust in motor.

I. Overload Protection: Built-in, automatically resetting, thermal-overload protection.

J. Noise Rating: Quiet.

K. Efficiency: Premium efficiency.

L. Nameplate: Indicate ratings, characteristics, construction, special features, and full identification of manufacturer.

M. Electrical devices and connections are specified in Division 26 Sections.

2.6 COIL SECTION

A. Coil Sections: Common or individual, insulated, stainless-steel casings for cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Provide stainless steel inner liner casing for cooling coil section only.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with electronic-expansion valve.
1. Coils shall be burst tested to 450 psig and proof tested to 300-psig air pressure, under water. After testing, insides of coils are to be dried; all connections are to be sealed and coil shall be shipped with a charge of dry nitrogen.
2. Suction headers shall be constructed of copper tubing. Suction connections shall penetrate unit casings to allow for sweat connections to refrigerant lines. Coils shall have equalizing vertical distributors sized according to the capacities of the coils. Coil casing shall be Type 304 stainless steel.

3. For coils units served by multiple compressor/condensing units, provided intertwined coils with full faced activation at part load conditions.
4. Suction and liquid line connections shall be clearly labeled on the outside of the unit.

D. Coil casing shall be Type 304 stainless steel.

E. Auxiliary Drain: Return bends and headers of coils shall be fully concealed within the air-handling unit. Provide auxiliary drain pan complete with drain connection at headered end of cooling coils. Exterior header covers will not be acceptable.

F. Coil Removal: Coils shall be removable from the unit at the header end, unless shown otherwise on drawings.

G. Refrigerant Leak Detection: Provide a refrigerant leak detection system per ASHRAE 15 that will sense a leak in refrigerant and can provide an output to initiate a refrigerant leak mitigation sequence.

2.7 ELECTRICAL HEATING COILS

A. Electric Coil (where indicated in schedule): Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and integral fused disconnect (one-time fuses) interlocked with door of heater coil.

B. Electrical Heating Coils, Controls, and Accessories: Comply with UL 1995.
1. Electric heat of capacity, voltage and control specified provided at unit discharge, or as indicated on drawings.
2. Casing Assembly: **G**alvanized-steel frame.
3. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
4. Coils shall be machine crimped into stainless steel terminals, which are insulated with high temperature ceramic insulators.
5. Provide internal wiring of controls, contactors, etc. including 120 volt, 60 hertz control circuit transformer, automatic reset thermal cutout and fuses per NEC and UL (on heaters exceeding 48 amps).
6. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or unit.
   a. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

7. Control Panel: **Unit** mounted with disconnecting means and overcurrent protection. Include the following controls:
   a. Magnetic contactor.
   b. Proportional electronic airflow sensor for proof of flow, independent of duct static pressure. Shall adjust heater capacity per available airflow
   c. Solid-state stepless pulse controller (SCR where noted).
   d. Time-delay relay.
   e. Pilot lights.
   f. Integral door interlock type disconnect switch.

g. Line terminal block.

2.8 AIR FILTRATION

A. General Requirements for Air Filtration Section: Shall be a part of the combination filter mixing box section. See sections below.
1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames constructed of extruded aluminum for increased rigidity arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
4. Galvanized steel with metal grid on outlet side for use with MERV 8 filter media, steel rod grid on inlet side, hinged access, and with pull and retaining handles.

B. Filter Media:
1. Provide disposable, pleated MERV 8 filters in the unit for use during startup. Contractor to replace filter media on a regular basis to maintain cleanliness in the AHU and duct system if unit is used during construction.
2. Upon substantial completion, provide new 4”, pleated MERV 13 filters with disposable frames in the AHUs.
3. Attic Stock: Provide galvanized filter frames and (1) set of MERV 8 filter media.

2.9 DAMPERS

A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating,".

B. All Dampers: Ultra-low leak (ULL), double-skin, airfoil-blade galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 3.7 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg.

C. Mixing boxes and filter-mixing boxes shall have parallel blades. All mixing boxes and filter mixing boxes shall have access doors as specified on both sides.

D. Coordinate damper actuators on damper shafts with controls.

E. Damper Operators: Comply with requirements in Division 23 Section "Instrumentation and Control for HVAC."

F. Combination Filter and Mixing Section:
1. See filter details above.

2.10 ACCESSORIES

A. See schedules.

2.11 CONTROLS

A. Air handler controls shall be achieved through programmable temperature/humidity sensor and CO2 sensor as specified in Section 230993.

B. AHU manufacturer shall coordinate with work of Section 230993 to ensure sensors can fully interact with the AHU without compromising any of the system safeties or warranties. BAS contractor shall provide each AHU with a dedicated controller capable of achieving sequences.

2.12 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic or refrigerant, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of air handling units.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Contractors providing units other than those used as the basis of design will assume all responsibility for changes required to accommodate units proposed.

3.2 INSTALLATION

A. Equipment Mounting: Install air-handling units on concrete bases **using elastomeric pads**. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 03 Sections.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using line size, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Insulate condensate lines.

E. Refrigerant Piping: Conform to applicable requirements of Division 23 Section "Refrigerant Piping." Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.

F. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories." Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

G. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

H. Ground equipment according to Division 26 Section "Grounding and Bonding."

I. 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.

J. Electrical and controls conduit connections at the AHUs: Seal the annulus of the conduit with fire-proof, air and water tight sealant to prevent air and condensate flow into or out of the AHU and FCU.

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.
   1. Inspect field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.
   2. Prepare a written report on findings and recommended corrective actions.

B. Tests and Inspections:

1. Leak Test: After installation, test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Manufacturer's Field Inspection: Engage a factory-authorized service representative to perform the following
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
7. Comb coil fins for parallel orientation.
8. Verify that proper thermal-overload protection is installed for electric coils.
9. Install new, clean filters.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
11. Inspect field assembly of components and installation of central-station air-handling units including refrigerant piping sizing and arrangement, ductwork, and electrical connections.
12. Prepare a written report on findings and recommended corrective actions

B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for modular indoor air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. Clean modular indoor air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

SECTION 260010 - SUMMARY OF ELECTRICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and other Division 26 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.

B. Scope of Work:

1. General: The "CSP#16-SBHVAC-1226 San Benito HVAC/Controls" consists of multiple existing buildings. These buildings will are generally operated from 7:00am to 6:00pm. (Monday through Friday) with occasional after hours and weekends use.
2. Electrical: Provide all materials and labor associated with complete operational electrical distribution system. Major items of work include, but are not limited to:

(a) Electrical Service: To remain as is with modifications.

(b) Demolition: Disconnect existing HVAC equipment for installation of new equipment as noted on drawings.

(c) Power Systems: Provide connections for new H.V.A.C. equipment.

(a) Fire Alarm System: Deprogram, disconnect existing HVAC duct smoke detectors, wiring and reconnect.

(b) Voice and Data Communications Cabling Equipment: Provide cabling, connectors, patch panels, racks, etc. to provide end-to-end connectivity for the HVAC controls.

(c) Commissioning: Provide for the HVAC as required per IECC 2018.

1.3 ALLOWANCES

A. Electrical: See Division 1 for electrical allowances.

1.4 COORDINATION

A. All electrical work shall be done under sub-contract to a General Contractor, who is ultimately responsible for the entire project. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.

B. All questions, requests for information, submittals, and correspondence from the Electrical Contractor shall be submitted via the General Contractor, who will forward to the Architect, who will then forward to the Engineer.

C. Electrical Contractor shall not make any changes to design without written authorization from the Engineer. If changes are requested by the Owner, Architect, General Contractor, Suppliers, Manufacturers, or any others, Contractor should issue a written RFI for response by the Engineer.

D. Electrical Contractor shall issue seven (7) days written notice prior to any activities that require the presence of the Engineer at the job-site. This applies to all inspections required by specifications, and particularly to those where work will be covered (underground raceways, electrical raceways above ceiling).

E. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

F. Fully coordinate with Mechanical Contractor for providing power to HVAC systems equipment.

G. Issue written notification of the following tasks and allow five (5) days for Engineer to respond and schedule an inspection as required:

1. Upon completion of installing all raceways, labeling all j-boxes.
2. Upon completion of pulling all wiring, making all terminations, labeling and color-coding wires at the panelboards/switchboards and prior to installing their covers.
3. When ready to request manufacturer’s start-up of each piece of equipment.
4. When ready for Substantial Completion Inspection.
5. When ready for Final Inspection.

H. Failure to issue written notification may result in work having to be redone to allow for proper inspection. It is this contractor’s responsibility to make sure Engineer receives notification.

1.5 UTILITIES

1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
2. Obtain any approvals required from utilities to relocate utilities.
3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.
4. Coordinate with utility for electrical service. Base bid shall include all costs associated with service connection, including permit fees.

1.6 CONTRACTOR USE OF PREMISES

A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:

1. Temporary fencing around construction areas.
2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
3. Temporary fencing around equipment while site work is in progress.

C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the job site.

1.7 SUBMITTALS - Special Requirements

A. All submittals need to comply with submittal requirements as outlined on this Pre-Construction Meeting Agenda & specifications.

B. Electrical Submittals shall be submitted electronically. Please organize the files as noted below (Native PDF format & searchable format). Files would need to be properly identified (cover letter, stamped, etc.) from the general contractor.

C. All submittals to be separated by sections and identified by section #s, in native and searchable pdf format. All selections/markings or highlighting made on the submittal shall be specific for project requirements and exactly for what the Contractor is intending to provide on the project. If submittal does not specify as to which model/options will be used by highlighting or marking the submittal, then submittal will be returned as rejected.

D. Manufacturer's standard dimensioned drawings, performance and product data shall be edited to delete reference to equipment, features, or information which is not applicable to the equipment being supplied for this project. Including Bill or List of Materials.

E. Individual submittals shall not be reviewed until a complete package is received.

F. Allow two weeks for initial review by Engineer, from the day it is received.

G. After released by GC, Subcontractor shall have one week to respond to our submittal/re-submittal review comments.

H. Allow one week for review of resubmittals by Engineer, from the day it is received.

I. All submittal review comments shall be forwarded by Engineer to Architect, who will then distribute as per Division 1.

J. Provide detailed coordination drawings showing how mechanical, electrical & plumbing system components will be installed in coordination with work by others. Engineer’s drawing files will be made available to Contractor for producing coordination and as-built drawings upon request.

1. Miscellaneous Electrical – Submittal #1

a. 260519 Low-Voltage Electrical Power Conductors and Cables
b. 260526 Grounding and Bonding for Electrical Systems
c. 260529 Hangers and Supports for Electrical Systems
d. 260533 Raceways and Boxes for Electrical Systems

e. 260553 Identification for Electrical Systems

2. Electrical Gear Submittal #2
a. 262816 Enclosed Switches and Circuit Breakers

3. Special Systems Submittal #3
a. 267210 Fire Alarm Systems

4. Electrical Commissioning Submittal #4
a. 260800 Commissioning for Electrical Systems

1.8 SCHEDULE OF VALUES -Special Requirements

A. Electrical Contractor shall submit a Schedule of Values reflecting the total value of Electrical Work in the Contract and broken down into the following items as a minimum, with a line item for Materials/Equipment and another for Labor.

ELECTRICAL
1. Electrical Gear.
2. Raceways Including Wiring.
3. Fire Alarm System.
4. Voice and Data Communications Cable Line Equipment
5. Commissioning
6. Allowances.
7. Miscellaneous.
8. Administrative and project management.

1.9 CODE COMPLIANCE:

The design for this project is based on:
1. Occupational Safety and Health Act (OSHA)
2. National Electric Code (NEC)
3. National Fire Code
4. International Building Code
5. UL 916
6. Local ordinances

END OF SECTION 260010

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. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturer:

1. Senator Wire & Cable Company.
2. Southwire Company.
3. Encore Wire

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2 and Type SO.

2.2 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

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.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

C. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports 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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

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 grounding and bonding systems and 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 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

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. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless **exothermic**-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Three-phase motor and appliance branch circuits.
3. Flexible raceway runs.
4. Metal-clad cable runs.
5. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

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.

3.4 FIELD QUALITY CONTROL

A. 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, at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each, 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.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. 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).
5. Manhole Grounds: 10 ohms.

E. 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. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Hangers.
b. Steel slotted support systems.
c. Nonmetallic support systems.
d. Trapeze hangers.
e. Clamps.
f. Turnbuckles.
g. Sockets.
h. Eye nuts.
i. Saddles.
j. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Nonmetallic slotted-channel systems.
4. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Material: Plain steel.
3. Channel Width: 1-1/4 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
    a. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
    b. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    c. Toggle Bolts: All-steel springhead type.
    d. Hanger Rods: Threaded steel.
    e. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
    f. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
    g. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
    h. Toggle Bolts: All-steel springhead type.
    i. Hanger Rods: Threaded steel

2.3 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 Section 055000 "Metal Fabrications" for steel shapes and plates.

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 unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in] NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMTs, and RMCs may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. 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 the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Architectural 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 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Sections "Exterior Painting", "Interior Painting" and "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 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. Metal wireways and auxiliary gutters.
3. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. EMT: Electrical metallic tubing.

C. FMC: Flexible metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

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

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Hylsa

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.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. FMC: Comply with UL 1; zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings:

a. Material: Steel (Zinc and malleable iron is not acceptable).
b. Type: set-screw.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Indoors or Type 4X stainless steel Outdoors unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Spring City Electrical Manufacturing Company.
10. Thomas & Betts Corporation.
11. Walker Systems, Inc.; Wiremold Company (The).

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, aluminum, Type FD, with gasketed cover.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

G. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

H. Gangable boxes are allowed as along is permitted by the NEC.

I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor applications and Type 4X (stainless steel) outdoor with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

J. Cabinets:

1. NEMA 250, Type 1, Type 4XSS 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: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4SS as noted on plans.

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.
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 trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.
3. 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.

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 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 Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

F. Support conduit within 12 inches of enclosures to which attached.

G. 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.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

J. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

K. 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.

L. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

M. 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.

N. 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.

O. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

P. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

R. 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.

S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

T. 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.

U. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.4 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 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 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.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. 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 clear adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

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. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical- resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical- resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

B. 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.

C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 30-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Power.
2. Control Wiring.

C. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

    a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:

        1) Phase A: Black.
        2) Phase B: Red.

3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

I. 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.

J. 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.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.

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. Labeling Instructions:

a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with

1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.

b. Distribution panelboards and Switchboards – label each circuit breaker

c. Access doors and panels for concealed electrical items.

d. Electrical switchgear and switchboards.

e. Disconnect switches.

3.3 INSTALLATION

Verify identity of each item before installing identification products.

END OF SECTION 260553

SECTION 260800 - 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 MEP systems, assemblies, and equipment:

B. Related Requirements:

1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements and Commissioning Coordinator responsibilities.

1.3 DEFINITIONS

A. Refer to Section 019113 "General Commissioning Requirements" for additional definitions and assignment of responsibilities.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. Refer to Section 019113 "General Commissioning Requirements".

B. Perform commissioning tests at the direction of the CxA.

C. Attend construction phase coordination meeting.

D. Participate in electrical systems, assemblies, equipment, and component maintenance orientation and inspection.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for complete range of testing for the required test period.

G. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

H. Direct and coordinate commissioning testing among subcontractors, suppliers, and vendors.

I. Verify testing and adjusting of Work are complete.

J. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

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

1.6 INFORMATIONAL SUBMITTALS

A. Construction Checklists: See related Sections for technical requirements, and generate construction checklists for the following:

1. Electrical Systems.

B. Certificates of readiness.

C. Certificates of completion of installation, pre-start, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Refer to Section 019113 "General Commissioning Requirements".

3.2 SYSTEMS READINESS CHECKLISTS

A. Construction Checklists: Assist CxA in the preparation of detailed Systems Readiness checklists for systems, subsystems, equipment, and components.

1. Contributors to the development of checklists shall include, but are not limited to:
   a. Systems and equipment installers.
   b. Electrical technicians.

B. Contractor shall conduct Systems Readiness Testing to document compliance with installation and Systems Readiness checklists prepared by Commissioning Authority for Division-26 items.

C. Refer to Section 019113 "General Commissioning Requirements" for issues relating to Systems Readiness checklists and testing, description of process, details on non-conformance issues relating to pre-functional checklists and test.

D. Contractor shall participate in Pre-Functional testing activities to document electrical work associated with mechanical and plumbing systems.

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 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 electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, and alarm conditions).

D. Inspect and verify the position of each device and interlocks identified on checklists.

E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

F. Testing Instrumentation: Install measuring instruments and logging devices to record test data as required.

3.5 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of automation system controllers and sensors.

C. Tests will be performed using design conditions whenever possible.

D. 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.

E. 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 electrical 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 FUNCTIONAL TEST PROCEDURES FOR SYSTEMS TO BE COMMISSIONED

A. General

1. The following paragraphs outline the functional test procedures for the various Div. 26 items to be commissioned. Functional testing will take place only after System Readiness checklists have been completed, equipment has been started-up, 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 CX Authority.

3.7 COMMISSIONING TESTS

A. All Electrical and Electrically Powered Equipment:

1. Inspect electrical wiring and grounding for proper connection, 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. Electrical Distribution System Switchboards and Panelboards:
1. Verify wiring connections are secure.
2. Verify ground wires are properly terminated.
3. Verify wiring color coding is correct.
4. Verify panel is properly identified.
5. Verify load identification is adequately descriptive of load.

C. Customized system readiness checklists and function testing requirements will be released after the submittal review phase.

3.8 TRAINING AND O&M MANUALS

A. Refer to Div. 26 specifications.

END OF SECTION 260800

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. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

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.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. 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.

D. Manufacturer's field service report.

1.6 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 Section 017823 "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. Submit on translucent log-log graph paper.

1.7 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. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. 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.

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 NFPA 70.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

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 and or Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's or Construction Manager's written permission.
4. Comply with NFPA 70E.

1.9 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 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Co.
2. Eaton Corporation.
3. Siemens
4. General Electric ABB

2.2 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac (as per connected voltage), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

B. 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.

C. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

2.4 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.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R OR 4XSS (as noted on drawings**)**.

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 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.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "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.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, 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:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: 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. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers 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.

END OF SECTION 262816

SECTION 267210 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Deprogram and disconnect existing duct smoke detectors at existing HVAC equipment to be removed. Reconnect and reprogram for new HVAC equipment. Coordinate work with owner's fire alarm.

B. Fully coordinate with the HVAC contractor for the Fire Alarm HVAC equipment (over 2,000 cfm's) duct smoke detectors interfacing.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. HVAC Controls - "Electric Control Systems for duct smoke detectors. HVAC down relay. (AHU shut down relay furnished by Fire Alarm Contractor).

D. Definitions:

1. FACP: Fire alarm control panel.
2. LED: Light-emitting diode.
3. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

E. System Description:

1. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.

F. Performance Requirements:

1. Comply with NFPA 72.
2. Fire alarm signal initiation shall be by one or more of the following devices:

a. Manual stations.
b. Heat detectors.
c. Smoke detectors.
d. Verified automatic alarm operation of smoke detectors.
e. Automatic sprinkler system water flow.
f. Fire extinguishing system operation.

3. Fire alarm signal shall initiate the following actions:

a. Visual notification appliances shall operate continuously.
b. Identify alarm at the FACP and remote annunciators.
c. Audible notification appliances shall operate continuously until silenced.
d. Visual notification appliances shall continue to operate until reset.
e. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
f. Release fire and smoke doors held open by magnetic door holders.
g. Transmit an alarm signal to the remote alarm receiving station

h. Record events in the system memory.

4. Supervisory signal initiation shall be by one or more of the following devices or actions:

   a. Operation of a fire-protection system valve tamper.
   b. Operation of a fire-protection system valve flow.

5. System trouble signal initiation shall be (per building) by one or more of the following devices or actions:

   a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
   b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
   c. Loss of primary power at the FACP.
   d. Ground or a single break in FACP internal circuits.
   e. Abnormal ac voltage at the FACP.
   f. A break in standby battery circuitry.
   g. Failure of battery charging.
   h. Abnormal position of any switch at the FACP or annunciator.

6. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators. Record event.

G. AHU SHUT DOWN

1. When a fire alarm condition is detected by AHU duct smoke detector and reported, the following functions shall immediately occur:

   a. The system alarm LED on the FACP shall flash.
   b. A local piezo electric signal in the control panel shall sound.
   c. A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
   d. This particular AHU shall be shut down only; the remaining AHU’s shall remain operational.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
2. Device Address List: Coordinate with final system programming.

3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
5. Batteries: Size calculations.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

F. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.

    a. Hard copies on paper to Owner, Architect, and authorities having jurisdiction.
    b. Electronic media may be provided to Architect and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer shall provide proof of their qualifications as Factory Authorized and Factory Trained for the product(s) specified herein. These documents shall be included in the submittal package. A letter from the manufacturer stating that the Contractor is the Factory Authorized Distributor for the submitted equipment shall be included in the submittal package.
2. The installing Contractor (Company) shall have completed a minimum of five projects of similar size and scope within the past five years. Provide a list of completed projects to include names and phone numbers of the Owner's representative and the General Contractor for the project.
3. Contractor Personnel Requirements:
    a. One full time employee with a current Texas Fire Alarm Planning Superintendents License.
    b. One full time employee with NICET Level III certification.
    c. A minimum of two technicians with Factory Training for the submitted product(s). Copies of License, NICET Certification, and Factory Training shall be included in the submittals.

d. The installation shall be performed by licensed full time employees of the Factory Authorized Distributor.

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. A factory-authorized Installer is to perform the Work of this Section. Installer is to be licensed by Texas Commission on Fire Protection as Fire Alarm Technician or Fire Alarm Planning Superintendent. Texas Commission on Fire Protection shall license installing company. Provide copies of licensing with submittal.

D. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction.

E. Comply with Article 5.43-2 Insurance code and fire alarm rules as required by Texas Commission on Fire Protection.

F. Comply with Article 5.43-2 Insurance code and fire alarm rules as required by Texas Commission on Fire Protection.

G. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:

1. NFPA 72, "Installation, Maintenance, and Use of Protective Signaling Systems."
2. NFPA 72E, "Automatic Fire Detectors."
3. NFPA 72G, "Guide for the Installation, Maintenance and Use of Notification Appliances for Protective Signaling Systems."

H. NRTL Listing: Provide systems and equipment that are listed and labeled.
1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

I. UL Compliance: All devices are to be UL listed for Fire, Security, and Access Control.

J. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility for system components.

1.4 WARRANTY

A. Guarantee all labor and equipment furnished under this bid package for a period of five (5) years commencing from the date of final system acceptance, including annual inspections of the system.

B. During the warranty period report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:

a. Notifier NFS-3030 - Existing No Substitutions

2. Wire and Cable:

a. Comtran Corporation.
b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
d. West Penn Wire/CDT; a division of Cable Design Technologies.

3. Audible and Visual Signals:

a. Edwards Systems Technology Inc.
b. Commercial Products Group.
c. Gentex Corporation.
d. System Sensor; a GE-Honeywell Company.

2.2 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Multipurpose type, containing the following:

a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
b. Heat sensor, combination rate-of-rise and fixed temperature.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

B. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

a. Sensor: LED or infrared light source with matching silicon-cell receiver.
b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated status. Provide remote status and alarm indicator and test station where indicated.
7. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.3 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Expand, modify, and supplement the existing control equipment as necessary to extend the existing control functions to the new points. New components shall be capable of

merging with the existing configuration without degrading the performance of either system.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Remote Status and Alarm Indicators: Install near each smoke detector that is not readily visible from normal viewing position.

E. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

1. NECA 1.
2. TIA/EIA 568-A.
3. Public areas with exposed structure, all wiring shall be concealed in raceway.
4. Stub up raceways into accessible ceiling space.
5. Install wiring in raceways except in accessible indoor ceiling spaces. Secure wiring from building structure steel (no walls) by means of J-hooks. Where available lay out cables in cable tray.
6. Conceal raceways and wiring except in unfinished spaces and as indicated.
7. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
8. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes for Electrical Systems."

1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and

back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

    a. Detectors that are outside their marked sensitivity range shall be replaced.

5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Semiannual Test and Inspection: Six months after date of Substantial Completion and for the following three years, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 267210

SECTION 269750 – VOICE AND DATA COMMUNICATION CABLE LINE EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. The primary scope of work is to provide a complete, "turn-key" structured cable infrastructure that will serve the district reliably for many years. All cabling, including copper and fiber optic, must be plenum rated. For building takeovers, vendor is responsible for removal of any existing cabling, rack, and network equipment, with guidance and approval of IDEA IT team.

B. Active network equipment (switches, access points, backup battery UPS, etc.) to be procured, installed, and configured by IDEA IT Department. Infrastructure components including but not limited to copper and fiber patch cables, patch panels, cable managers, racks, cabling, ladder, cable tray, fiber distribution panels, pig tails etc., to be provided and installed by contractor.

1.2 CODES AND STANDARDS

A. General: All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation and workmanship shall comply with the latest editions of the requirements of the Authority Having Jurisdiction (AHJ), National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the Contractor shall satisfy most stringent requirements.

A. Codes:

1. Insulated Cable Engineers Association (ICEA)
2. ANSI/ICEA S-80-576-2002, Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems
3. ANSI/ICEA S-84-608-2002, Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor
4. ANSI/ICEA S-90-661-2002, Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems
5. ICEA S-102-700-2004, ICEA Standard for Category 6 Individually Unshielded Twisted-Pair Indoor Cables for Use in LAN Communication Wiring Systems Technical Requirements, 2004
6. National Fire Protection Association (NFPA)
7. NFPA 70, National Electrical Code® (NEC®)
8. NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces,
9. NFPA 72, National Fire Alarm Code®
10. NFPA 75, Standard for the Protection of Electronic Computer/Data Processing Equipment
11. NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities

12. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
13. NFPA 101, Life Safety Code®
14. NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
15. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
16. NFPA 780, Standard for the Installation of Lightning Protection Systems
17. NFPA 5000™, Building Construction and Safety Code

B. Reference Standards

1. Telecommunications Industry Association (TIA)
1. ANSI/NECA/BICSI 568-2006, Standard for Installing Telecommunications Systems
2. ANSI X3T9.5, Requirements for UTP at 100 Mbps
3. ANSI/TIA-526.7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
4. ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
5. ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard
6. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard
7. ANSI/TIA-568.3-D, Optical Fiber Cabling and Components Standard
8. ANSI/TIA-568-C.4, Broadband Coaxial Cabling and Components Standard
9. ANSI/TIA-569-D, Telecommunications Pathways and Spaces
10. ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructures
11. ANSI/TIA-862-B, Structured Cabling Infrastructure Standard for Intelligent Building Systems
12. ANSI/TIA-942-B, Telecommunications Infrastructure Standard for Data Centers
13. ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) for customer Premises
14. T-526-14-C, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
15. TIA-598-D, Optical Fiber Cable Color Coding
16. TIA-604.3-B, FOCIS 3—Fiber Optic Connector Intermateablility Standard, Type SC
17. TIA-604.10-B, FOCIS 10—Fiber Optic Connector Intermateablility Standard, Type LC
18. TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
19. TIA-758-B, Customer-owned Outside Plant Telecommunications Infrastructure Standard
20. TSB-155-A, Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

C. Other Reference Materials

1. ANSI/NECA/BICSI-568-2006, Standard, Installing Commercial Building Telecommunications Cabling
1. BICSI Outside Plant Design Reference Manual (COOSP), current edition.
2. BICSI Electronic Safety and Security Reference Manual (ESSDRM), current edition

3. BICSI Information Transport Systems Installation Methods Manual (ITSIM), current edition
4. BICSI Network Design Reference Manual (NDRM), current edition
5. BICSI Telecommunications Distribution Methods Manual (TDMM), current edition
6. BICSI Wireless Design Reference Manual (WDRM), current edition
7. Institute of Electrical and Electronic Engineers (IEEE)
8. National Electrical Manufacturers Association (NEMA)
9. Underwriters Laboratories (UL) Cable Certification and Follow Up Program

B. The Vendor will follow the National Electric Code (NEC), the National Electric Safety Code (NESC), and any applicable State of Texas code, and local codes

1.2 TECHNOLOGY SYSTEM DESIGN REQUIREMENTS

A. All data and communications cabling, voice, audio-video and projects are bid and contracted through the General Contractor scope of work. The structured cabling, IT rack fabrication, electrical back boxes, raceways, and conduit needed to support these systems and services are to be included in design and construction documents.

B. Communications and data and voice cabling projects are separate from audio-visual, video, security, building control systems that are not directly associated with IDEA's IP-based network and voice systems.

C. 100% Schematic Design Milestone Requirements:
1. Identify all telecommunication rooms, service entrances and all backbone pathways. Determine the room dimensions of all telecommunication rooms.
    a. Telecommunication rooms shall be positioned to be within 300 feet of horizontal distance from the farthest outlet point (using right angle measurements). Final locations of all IDFs, including the intended primary path(s) of horizontal cabling and the associated 300-foot rule must be presented to and approved by IDEA network team prior to the architectural layout being approved by IDEA IT project management.

D. 100% Design Development Milestone Requirements:
1. Finalize all telecommunication rooms, service entrances and all backbone pathways. Plans shall include schematic layouts of headend closets, legends, and details.

E. 50% Construction Document Milestone Requirements:
1. Include site and floor plans, endpoint drops/locations, cable pathways, headend room layouts, backbone schematic diagrams and telecommunication specifications.

F. 100% Construction Document Milestone Requirements:
1. Include backbone riser diagrams for all intra-building cross connects and interbuilding cross-connect locations. Also include service entrances and headend room layouts, wall elevations of all communication rooms, rack elevations, grounding busbar, termination boards, conduits, cables trays, floor penetration locations and pull boxes.
2. Detailed room layouts indicating all technology endpoint outlets with identification to determine number of drops per location/outlet and their designated telecommunication room.
3. 100% Data and voice communications specifications

G. Submittals Milestone Requirements:
   1. Follow the submittal requirements and procedure
   2. Owner to review Contractor's BOM (Bill of Materials)

H. ***The IDEA IT & Technology Department shall review and approve drawings after each design milestone and close-out deliverables.***

I. At time of construction award, notice of final data cabling subcontractor selection and contact information to be made available to IDEA IT & Technology for visibility and coordination.

J. ***The architect shall coordinate;***
   1. ***all service entrances underground conduit to be located adjacent to existing utilities entering the site.***
   2. ***the location of all classroom projector setups, and conference room flat digital displays, providing each student with proper visibility of the board.***
   3. ***the location of all teacher and admin workstations***

1.3 WORK INCLUDES

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

B. Provide a CommScope Uniprise data and telephone cable plant with a 25-Year Extended Product Warranty and Application Assurance per District standards

C. Communication Systems complete including structured cabling, patch cords, special backboxes, hardware and all other required devices and equipment.

D. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the communication systems as shown on the drawings and as specified herein.

E. Installation of system equipment per specifications.

F. Coordinate cable pathways, conduit, cable support systems, power, and outlet requirements with the builder and the electrical contractor.

G. It is the intent of these specifications to provide complete installation although every item necessary may not be specifically mentioned or shown.

1.4 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

A. Provide required utility services conduit as outlined on drawings.

B. All required conduit for accessibility to attic space.

C. Furnishing and installation of all standard back boxes, conduit, floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.

D. Installation of special back boxes supplied by Division 27 contractor(s).

E. Provide equipment-mounting boards as outlined on drawings.

F. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.

G. Provide 120-volt power and hook-up to equipment provided in Division 26.

H. Coordination of requirements of Division 26 with the Builder.

1.5 WORK NOT INCLUDED

A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection, purchase, or installation of interconnect instruments/equipment to be used on this project.

1.6 SUBMITTALS

A. Product Data: Include data on features, ratings, and performance for each component specified. Additional details in Section 1.6 L.

B. Shop Drawings: Include dimensioned plan, requirements listed below, and elevation views of components. Additional details in Section 1.6 M.

1. System / endpoint cable identification labeling schedules, including an additional electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.
2. Fiber pathways and interconnects between MDF and IDF rooms
3. Total cable drop counts per IT closet (MDF/IDF) assignment
4. Cable drop counts per purpose/room/outlet
5. IT rack elevation and patch panel port assignment list – coordinate with Owner - additional details in Section 10
6. Conduit sleeves routed and penetrated to MDF/IDF rooms
7. Conduit sleeve location shown in each room connecting to corridor
8. Ground bar location and bonding to each rack and cable support system components

C. Bill of Materials: Include a list of part #s, descriptions, quantities

D. Samples: For workstation outlet connectors, jacks, jack assemblies, and faceplates for color se- lection and evaluation of technical features.

E. Product Certificates: Signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article. Provide evidence of Current CommScope certification. Contractor shall be certified under manufacture before bid date.

G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Copper and fiber cable certifications are required for IDEA IT network to review for any existing building takeovers with plans to re-use cabling.

H. Maintenance Data: For products to include in maintenance manuals specified in Division 1 found in Construction Specs document.

I. Submittal procedures shall be per Division 1 - General Requirements.

J. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.

K. Submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.

L. Each Product data submittal shall include:
   1. A cover sheet with the name and location of the project, the name, address, and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
   2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
   3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
   4. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
   5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
   6. When the contract requires extended product warranties, submit a sample of warranty language.
   7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.

M. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary, guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.

N. The Engineer's and Owner review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.7 QUALITY ASSURANCE

A. Proposed Contractor Qualifications:

1. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
2. Contractor shall have installed similar systems in at least (5) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Contractor shall provide information on prior pro- jects including, but no limited to: items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc
3. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
4. The proposed contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period. The contractor shall be capable of dispatching technicians to repair a system within six hours of a service request.
5. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. This list must contain at least two (2) projects within a 150-mile radius of the proposed project to allow owner's officials to visit the job site for review of the system installation and service. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.
6. An experienced installer who is a registered communication distribution designer certified by the Building Industry Consulting Service International (BICSI).
7. The Contractor (Company) shall have a minimum of two full time employees' who have completed the Manufacturers Certification for the submitted product(s). Copies of Certification shall be included in the submittals.
8. The head installer should be a Registered Communication Distribution Designer (RCDD) and should follow all BICSI recommendations for Telecommunication Infrastructure Copper and Fiber installations.
9. The Contractor (Company) must be able to prove to the satisfaction of the Owner/Engineer that it has significant experience in the installation of fiber optics cable systems and communication systems. Installation must include installation of fiber optics cable, fiber termination, a knowledge of interconnect equipment, and a thorough knowledge of testing procedures.
10. The Contractor (company) shall provide current CommScope certification before bid date.
11. The Contractor shall not sub any portion of the scope of work. This scope shall be performed and certified by contractor awarded.

12. The ability of a proposed contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the contractors' competency and responsibility to meet the requirements and obligations of the contract.
13. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
14. The Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed contractor shall furnish to the Owner with any information or data requested for this purpose.
15. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
16. The Owner reserves the right to reject the proposal of any contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

B. Codes: Comply with applicable sections of the following for interior and exterior installations. Ensure you are using the latest and most current standards and regulations applicable.

1. International Building Code (IBC)
2. National Electrical Code (NEC/NFPA 70, 101, 2002)
3. National Electrical Safety Code (NES IEEE C2-1997)
4. IEEE Std. 1100-1999 Recommended Practice for Powering and Grounding Sensitive Electronic.
5. IEEE-SA 802.3, 803.11, and 803.16 series Standards for Ethernet, PoE, and Wi-Fi Information Technology.
6. Local Codes, amendments, and ordinances.
7. ANSI/TIA Standards, current revisions of 568, 569, 606, 607, 1152 standards

C. Comply with NFPA 70.

D. 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 in- tended use.

1.8 WARRANTY

A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.

B. Neither the final payment nor any provisions in Contract Documents shall relieve the 18 Contractor of the responsibility for faulty materials or workmanship.

C. He shall remedy any defects due thereto and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.

D. The Owner shall give notice of observed defects with reasonable promptness.

E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

F. The guarantee shall be such, that during the 25-year period, if Owner determines that any cable no longer certifies, the contractor shall correct it within 5 working days.

1.9 COORDINATION

A. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

B. Coordinate work of this section with IDEA IT Network Services Department for their system specifications, telephone instruments, workstations, equipment suppliers, etc.

1.10 PLANS AND SPECIFICATIONS

A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.

B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.

C. Install the work complete including minor details necessary to perform the function indicated. Provide communication systems (including all hook-ups) complete in every respect and ready to operate.

D. If clarification is needed, consult the Architect/Engineer.

E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.

F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.11 MANUFACTURERS' INSTRUCTIONS

A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.

B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.

C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.12 ACCEPTABLE MANUFACTURERS AND SUBSTITUTIONS

A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.

B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.

C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.

D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.

E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.

F. It is the responsibility of the Contractor to provide all features and functions as outlined in these specifications. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

G. The selected contractor must be a certified Integrator/Installer authorized by one of the Manufacturers listed below to provide an extended warranty to the Owner covering all network cable and connectivity hardware products comprising this installation site. All UTP cable, fiber optic cable, and all wiring devices installed shall be products of one approved manufacturer or joint manufacturers program and approved for use in their extended warranty program. The Contractor and Manufacturer shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship; provide a copy of contractor certification.

H. The manufacturers model numbers, functions, and features described in this specification section are those of the CommScope Uniprise with a 25-Year Extended Product Warranty and Application Assurance per District standards, no exceptions.

I. The Contractors’ proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.

J. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.

K. Requests for substitution are understood to mean that the Contractor:
   1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
   2. Will provide the same guarantee for the substitution that he would for that specified.
   3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
   4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
      a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
      b. The specified product is unavailable through no fault of the Contractor.
      c. The manufacturer refuses to warranty the specified products as required.
      d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
      e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
      f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

1.13 FUTURE USE CABLING

A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.

B. LOCATIONS AND EXISTING CONDITIONS:
   1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
   2. The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.14 PROTECTION OF EQUIPMENT AND MATERIALS

A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.

B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.

C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.15 CUTTING AND PATCHING

A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.

B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.

C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.

D. Patching of openings and/or alterations shall be provided by the communications Subcontractor or at the Subcontractor's expense in an approved manner.

E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.

F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.

G. All openings in exterior walls shall be sealed watertight.

H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

1.16 INSTALLATION

A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.

B. The Communications Contractor shall coordinate installation of the communication systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to insure a complete working system for the Owner.

C. Where required for accessibility all conduit and boxes for all communication systems shall be provided by the Electrical contractor as specified, including systems in Division 27, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with and verify with Division 26 to provide required conduit and boxes at locations and heights as required.

D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.

E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.

F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.

G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.

H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.17 FINAL OBSERVATION

A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer and Owner to make a final observation.

B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.

C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
   1. Final clean up completed.
   2. All systems are fully operational, all material and devices installed.
   3. As built (as installed) drawings and operations manuals

D. Final observation is required with the Owner (including IT-network team) to approve IT infrastructure and signoff on the acceptance.

1.18 DRAWINGS, MANUALS, AND TRAINING

A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format.

B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.

C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Place final cable certification test results in manuals.

D. All cable paths and wiring methodology shall be documented. All cables shall have both ends labeled and included in the as-built documentation. Provide an MS Excel worksheet compatible format spreadsheet file cross referencing all cable run numbers, architectural room number, and owners room number for the origin and destination of each cable run.

E. A formal on-site training session shall be provided by the Contractor to the Owners Representative / Maintenance personnel and shall include instruction on the documentation, location, inspection, maintenance, testing, and operation of all system components. Provide a minimum of two (2) hours of documented general instruction.

F. A list of building systems and hardware devices requiring connection to Owners IT network must be completed per IT specifications/spreadsheet. Additional details in Section 1.6 L.

1.19 QUALITY ASSURANCE

A. All Vendors must meet all applicable codes / standards defined below, and any others that may be defined.

B. The Vendor will follow the National Electric Code (NEC), the National Electric Safety Code (NESC), any applicable State of Texas code, and local codes.

C. The Vendor will provide materials and equipment that is new and will conform to the NEMA, UL, ANSI, IEEE, and IPCEA standards. All cabling will follow the BISCI standards of installation, testing and maintenance.

D. The vendor is required to provide a CommScope 25-year Extend Product Warranty and Application Assurance at job completion.

E. Standards:

1. ANSI/TIA/EIA Standards 568D - Commercial Building Telecommunications Cabling Standard
2. ANSI/TIA/EIA Standard 569 - Commercial Building Standards for Telecommunications Pathways and Spaces
3. ANSI/TIA/EIA - 606 - Administration Standard of the Infrastructure of Commercial Buildings
4. ANSI/TIA/EIA - 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
5. ANSI/TIA/EIA - 758 - Customer Owned Plant Telecommunications Cabling Standard
6. TSB-67, 95, and 72 - Testing standards and reporting

PART 2 - SCOPE OF PROJECT/SCOPE OF WORK

2.1 SCOPE OF WORK

A. The Horizontal Structured Cabling System shall consist of Category 6 cables routed and secured from the Telecommunications Room on each floor to the outlets as shown on drawings. All Category 6 will terminate in the Telecommunications Room on 24-port and 48-port Category 6 patch panels. Wire management shall be used to provide cable management above, below and to each side of the patch panel.

B. All structured cabling shall be from a single manufacturer to insure optimum performance.

C. Provide a CommScope Uniprise data and telephone cable plant with a 25-Year Extended Product Warranty and Application Assurance per District standards

D. Contractor will provide all materials to place and terminate all outlet types.

E. Contractor will be responsible for supplying and coordinating the delivery of fiber and copper patch cords.
   1. Delivery date will be prior to substantial completion date and agreed upon between Owner and Contractor.
   2. A transmittal sheet showing list of parts and quantities must be signed by the Owner authorized person.

F. Owner will be responsible for fiber and copper patch cord installation.

G. Cable Routing and Installation

   1. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical code requirements.
   2. The cable support system shall provide a protective pathway, using J-hooks, to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling. Detailed information on cable installation in Section 9.
   3. Horizontal cabling must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel with line voltage electrical conductors.
   4. For Work Area outlets/endpoints, each cable run shall include a 20-foot service loop with Velcro hook ties located above the ceiling. This is to allow for future relocation, re-termination, or repair.
   5. For MDF/IDF rooms, each cable run shall include a three-foot service loop with Velcro hook ties located in the ceiling above the rack. This is to allow for future re-termination or repair.

2.2 BACKBONE-FIBER

A. The Backbone Fiber Riser System shall consist of fiber cables with 12 (twelve) 50-um OM4 multimode interlocking armor cable placed from the each IDF and terminating in the MDF, as shown on the drawings.

B. Sharp edges of interlocking armor will be terminated with MC-type connector and attached to Rack mount bracket or to Fiber shelf.

C. Interlocking armor will be bonded to ground per manufacturer's instructions.

D. All fiber terminations shall be fusion spliced pigtails with LC connectors.

E. Fiber will be terminated and routed through rack mount fiber panels.

F. Duplex LC OM4 riser-rated patch cords will be provided for each closet.

2.3 CABLE SUPPORT

A. Conduit, duct, or track shall be used for communication cable in exposed areas.

B. Cable fill shall not exceed the manufacturers' instructions for each type of support.

C. All conduit, ducts, track, and raceways

D. Solid, ladder, or mesh cable tray/duct shall be required for narrow depth cable routes that would allow sags to rest upon the ceiling, electrical conduits, HVAC equipment, ducts, or lighting fixtures.

E. Vertical cable runs exceeding 12" in equipment closets shall require ladder or mesh type cable support tray. Attachment shall utilize appropriate mounting hardware and accessories for vertical placement and allow a minimum of 2" clearance between the wall and runway. Cable attachment shall be made by Velcro hook ties in a basket type configuration.

F. All vertical supports shall be attached to the building support structure or concrete ceiling with anchors load rated for 100-lbs. minimum. Down rods shall be a minimum of 1/4" diameter. Steel uni-strut cross supports shall be 2" minimum.

G. Cable runway or tray shall be grounded to an appropriate building ground at each end and bonded at each joint.

H. Rubber or plastic boots shall be installed at the ends of horizontal support rails to prevent cable damage or injuries to personnel.

2.4 J-HOOKS

A. The cabling from the Telecommunications Rooms will be routed to their respective outlets utilizing J-Hooks above ceiling and below floor. Cables will be bundled in groups of less than 50 and placed no more than 5' apart following the pathway from Telecommunications Room to work area outlet. J-Hooks and all mounting hardware as well as any placement of these devices are the responsibility of the contractor.

B. Attachments for cabling support shall be spaced at approximately 48 to 60 inches on center. Cable bundles shall not be allowed to sag down more than 12-inches mid-span between attachments.

C. Category 6, all attachments shall be approved for Category 6 cabling. Attachments shall be Caddy part numbers as follow, or approved equal, sized as follows:
   1. CAT16HP, 1” diameter Capacity 15 Category 6 cables.
   2. CAT21HP, 1.31” diameter Capacity 40 Category 6 cables.
   3. CAT32HP, 2” diameter Capacity 60 Category 6 cables.
   4. Split bundles greater than 2" dia. or provide cable tray.

D. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm with data and telephone cable). Multiple J-Hooks can be placed on the same attachment point, up to the rated weight load of the attachment device.

2.5 RACK HARDWARE

A. Rack Hardware will be utilized in the IDF’s and MDF to house terminated Category 6 patch panels, fiber termination hardware, and network switch equipment. All rack hardware will be secured to the floor with appropriate hardware and overhead by cable tray. All racks will be 7 feet in height and 19 inches wide with 3-inch channels.

B. Vertical cable management will be utilized between each rack and at the end of each rack row to manage vertical patch cables (in front) and horizontal cable runs (in back). 6” vertical cable managers will be used between racks to provide cable management vertically.

C. Alternately, as noted on the drawings, wall-mounted racks shall be utilized in the IDF to house terminated Category 6 patch panels, fiber termination hardware, and network switch equipment. All rack hardware will be secured to the wall with appropriate hardware.

D. All rack hardware shall be grounded to an approved building ground.

2.6 CABLE VELCRO WRAPS (PLENUM RATED)

A. Plenum rated Velcro hook cable ties shall be furnished and installed to attach wire bundles to supports and for appropriate wire management as required. Provide and install Panduit TAK-TY HLTP series cable ties with UL 94-V2 flammability rating, or approved equal.

B. Hard plastic or metal tie wraps will not be allowed on any data cable (Category rated UTP).

2.7 MEASURING PULLING TAPE (MULE TAPE)

A. All future use innerduct and conduit cable pathways shall include a Measuring Pulling Tape (Mule Tape) made of woven Polyester, Aramid, Kevlar, or an equivalent fiber blend. Measuring Pulling Tape shall have a minimum tensile strength of 1250 lbf. or as required and shall be pre-lubricated for prevention of burn though and marked for measuring in feet.

B. Measuring Pulling Tape installed in underground pathways shall incorporate a 22-gauge minimum solid corrosion resistant copper conductor for use in radio signal locating procedures.

2.8 CABLE AND LADDER TRAY

A. The Cable Tray in a Telecommunications Room / Equipment Room shall be placed to allow easy access into the room and formed as shown on drawings. Tray shall route cables from room entrance to their termination location. Tray shall use a standoff bracket to allow cables to be routed above racks and flow easily into vertical managers.
B. All cable trays shall be grounded to ground bar located in the termination location.
C. CPI Junction Splice kit Model #11302-X01 (Black in Color)
D. CPI Support Bracket Model #11312-X12 (Black in Color)
E. CPI Cable tray Model #10250-X12 (Black in Color)
F. CPI Elevation Kit Cabinet Model #10506-X12 (Black in Color)
G. CPI Elevation Kit Rack Model #10506-X06 (Black in Color)
H. CPI Runway radius drop Model #10506-X12 (Black in Color)
I. CPI Elevation Kit Cabinet Model #12100-712 (Black in Color)
J. CPI "L" bracket Model #11268-001 (Black in Color)
K. CPI Butt-Splice Kit Model #11301-X01 (Black in Color)
L. CPI Rack to Runway mounting plate Model #10595-X12 (Black in Color)
M. CPI Wall angle support kit Model #11421-7-12 (Black in Color)
N. CPI Foot Kit Model #11309-X01 (Black in Color)
O. CPI Elevation Kit Cabinet Model #10506-X12 (Black in Color)
P. CPI Vertical Wall Brackets Model #10608-X01 (Black in Color)
Q. CPI Grounding BusBar Model #13622-012.
    1. CPI Strap Kit #40164-001
    2. CPI Ground Terminal Block #08009-001
    3. Superior Essex Ground Wire #12-018-04 (Green in Color)
    4. 3M Shield Bond connectors #4460-D
R. CPI Elevation Kit Cabinet Model #10506-X12 (Black in Color)
S. CPI Power Strip Cabinet Model #12820-705 (Black in Color)

2.9 FIRE-STOPPING SYSTEMS

A. Suitable fire-stopping shall be used to prevent the spread of smoke and fire throughout the building. Contractor will be responsible for installing fire-stopping system for every wall or floor penetration as required by code.

2.10 UPS

A. An Uninterruptible Power System shall be placed into each Telecommunications Room to provide conditioned power and back-up in case of power failure. UPS shall be mounted in the bottom of the rack housing the network equipment. Owner is responsible for ordering and installing this unit.

2.11 GROUNDING

A. Contractor shall provide a ground bar at each termination location (Telecommunications Rooms and Equipment Room). Contractor shall provide a #6 AWG stranded copper wire cable between ground bars located at each TR and ER to the building main service ground point.
B. This ground conductor shall be utilized for grounding termination equipment, equipment rack and cable tray.

PART 3 - TELECOMMUNICATION NETWORK SYSTEM REQUIREMENTS

3.1 The Structured Cabling System shall consist of any one or all of the following structured cabling elements or subsystems:

A. Work area
B. Horizontal cabling
C. Telecommunications room (or horizontal cross connect)
D. Backbone cabling
E. Equipment room
F. Entrance facility
G. All cable support structure

3.2 SUPPORTED APPLICATIONS

A. The Structured Cabling System shall be capable of supporting and/or integrating the following:
   1. Analogue and digital voice applications
   2. Data applications
   3. Local area network services
   4. Wide area network services
   5. Video /Imaging services
   6. Low voltage devices for building controls

3.3 Additional requirements

A. Categorized copper product shall be used in conjunction with an equivalent or higher Category cable as verified by ETL or TSV.

B. All structured cabling products shall be installed according to any applicable instructions.

C. All networks and other applications shall be installed per applicable Owner standards and manufacturers' guidelines and transmitted over the appropriate minimum Category copper cable or fiber cable for which it was intended to operate on.

D. All applicable local, state, national, and federal electrical and fire safety standards shall be adhered to during and after installation.

PART 4 - WORK AREA OUTLET

4.1 The Work Area shall consist of the connectivity equipment used to connect the horizontal cabling subsystem and the equipment in the work area. The connectivity equipment shall include the following options:

A. Patch (equipment) cords
B. Faceplates

4.2 Category 6 Copper Outlets

A. All category 6 information outlets designed for termination of 4-pair balanced twisted-pair category 6 copper cables must possess the following characteristics at the minimum:

1. Be able to be a gravity feed (45 degree angled) as well as flush mount utilizing the same jack.
2. Have 110 style insulation displacement connectors with quadrant pair isolation and a pyramid wire entry system. Termination is accomplished with a single conductor impact tool.
3. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity.
4. Have rear protective strain relief caps rear entry, which will be installed onto cable after termination.
5. Support industry standards for T568A or T568B wiring options (568B wiring scheme applicable to this project) on each individual outlet.
6. Be side-stackable for high-density solutions.
7. Provide color-coded and labeled for VOICE, DATA or Blank, Snap-In icons for circuit identification.
8. Be constructed of high impact, flame-retardant thermoplastic.
9. Must be Third Party Verified to all claims.
10. Verified to ETL TSV performance in a channel

4.3 Face/Wall plates

A. The faceplates shall support the network system by providing high-density in-wall, surface mount or modular office furniture cabling applications. The outlets consist of faceplates for flush and recessed in-wall mounting as well as mounting to the modular office furniture systems. The surface mount boxes can be mounted where in-wall applications are not possible or to support applications where surface mount is the best option.

B. Faceplates shall be available in single-gang design in White and available in (1,2, or 3) port openings.. They shall feature openings on both sides to allow easy identification of the ports and accept M-series Uniprise information outlets. They shall come equipped with mounting screws, label covers, and label cards.

1. CommScope – M13L-262 (3-port outlet)
2. CommScope – M12L-262 (2-port outlet)
3. CommScope – M10L-262 (1-port outlet)

C. Outlets at faceplate will color code according to application

1. CommScope Uniprise- UNJ600-BL (for all Data Drops)
2. CommScope Uniprise- UNJ600-GN (for all WAP Drops)
3. CommScope Uniprise- UNJ600-VL (for all Projectors)
4. CommScope Uniprise- UNJ600-OR (for all Analog)
5. CommScope Uniprise- UNJ600-YL (for all Security Cameras)
6. CommScope Uniprise- UNJ600-262 White (for all intercom)

4.4 Above Ceiling/Structure Mounted Jack Locations

1. Jack type to match colors above and shall be as follows:
2. CommScope part number 760248521 | SMB-1P-262 securely mounted to structure above the finished ceiling with Category 6 jacks and blanks as required.

4.5 Patch Cords

A. All category 6 Patch (Work-area) Cords shall use 4-pair balanced twisted-pair category 6 23 AWG stranded twisted pair copper cable and be available in both Booted and Non-Booted options.

B. For work area data drops, we require the following length and quantity of patch cords.
   1. Fifty (50) CAT 6 work area patch cord, 10 feet in length and Blue in color shall be provided. UC1BBB2-0ZF010
   2. Ten (10) CAT 6 work area patch cord, 15 feet in length and Blue in color shall be provided. UC1BBB2-0ZF015
   3. Five (5) CAT 6 work area patch cord, 25 feet in length and Blue in color shall be provided. UC1BBB2-0ZF025
   4. Two (2) CAT 6 work area patch cord, 50 feet in length and Blue in color shall be provided. UC1BBB2-0ZF050

C. For WAP Drops, provide one Green category 6 10’ patch cord per drop. UC1BBB2-0MF010

D. For Projector Drops, provide one Purple category 6 10’ patch cord per drop. UC1BBB2-0LF010

E. For Analog Drops, provide one Orange category 6 10’ patch cord per drop. UC1BBB2-06F010

F. For Security Camera Drops, provide one Yellow category 6 10’ patch cord per drop. UC1BBB2-09F010

G. For Intercom Drops, provide one White category 6 10’ patch cord per drop. UC1BBB2-08F010

H. Patch cords shall be from the same manufacturer as the horizontal cabling to insure optimum performance.

PART 5 - HORIZONTAL CABLING SUBSYSTEM

5.1 The horizontal cabling system is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the TC.

A. Horizontal cabling in an office should terminate in a TC located on the same floor as the work area being served

B. Horizontal cabling is installed in a star topology (home run)

C. Bridged taps and splices are not permitted as part of the copper horizontal cabling

5.2 Copper UTP Cable

A. Category 6 UTP Cable
   1. * Maximum cable length is 90 meters

a. Cat 6 - CommScope CS37P – Plenum-rated

B. These requirements are for cables of four unshielded twisted pairs of 23 AWG bare copper, thermoplastic insulated solid conductors enclosed by a thermoplastic jacket. The finished cable shall exceed the requirements of ANSI/TIA/EIA-568-B.2-1 Category 6.

C. All cable shall conform to the requirements for communications circuits defined by the National Electrical Code (Article 800) and the Canadian Building Code. All cable shall be listed with an OSHA approved laboratory and carry labeling of either CMP or CMR whichever is appropriate for the installation environment.

D. The cable manufacturer shall be ISO 9001 registered.

5.3 Cabling Testing Criteria

1. Tested to 650 MHz
2. Maximum Delay Skew < or = 25 ns
3. Typical Positive Power Sum ACR ≥ 400 MHz
4. Capacitance Unbalance of 58.2 pF Max @ 23 degrees Celsius.
5. Typical PSUM NEXT & NEXT ≥ 10dB better than category 6 standard

5.4 Cable Color Scheme

A. Color scheme for cable runs and patch cables are indicated below. Selected cabling vendor should confirm quantity of each with construction and IT to ensure correct number and type of runs.

B. The color code shall be as follows:

Purpose	**Color**
Data (wall jacks)	Blue
Wireless Access Points	Green
Projectors	Purple
Analog (security/fire/elevator x-connect)	Orange
Security Cameras	Yellow
Intercom	White

5.5 Cable Run Designator Labeling Scheme

A. Each patch panel jack, wall plate jack, terminal cabinet connector, both ends of each cable run and on the ceiling grid bar at jack locations that are concealed above a drop ceiling shall be labeled with a cable scheme run designator machine printed labels installed according to EIA/TIA 606 standards. All labeling shall conform to industry standards and best practices. Labeling types and scheme shall be verified and coordinated with the Owner prior to any installation.

B. Patch panels are to be labeled based on room number (or closet number), sequential order and purpose as indicated in the below example.
   1. 24-port patch panels are the first and last patch panels in the rack.
   2. Therefore, patch panel A will range from A01-A24; patch panel B01-B48; etc.

C. <Room #>-<Patch Panel #><Port# on patch panel>-<Purpose>

IT Closet (Patch Panel)	***Room (Faceplate)***
RM228-A04-AP	MDF123-A04-AP
RM228-A05-P	MDF123-A05-P
RM228-A06-D	MDF123-A06-D

Note: Patch panel # is indicated by letter. (A, B, C, etc.)

D. Third-Party Building Systems are to be terminated on the patch panel and labeled as indicated below. At the device, the cable should be labeled indicating closet and patch panel label. No devices should be connected directly into the switch and third-party vendors are expected to coordinate needed drops with the selected cabling vendor.

IT Closet (Patch Panel)	***Device***
RM123-HVAC001	MDF123-B46-HVAC001
RM123-LGHT001	MDF123-B47-LGHT001
RM123-MRQ001	MDF123-B48-MRQ001

E. Fire/Security/Elevator Cross Connects.
1. Cross connect cables should be labeled at the demarc punch block to indicate purpose using a wrap around tag. On the far end panel, the cable should be labeled with the phone number using a wrap around label

Demarc/Punch Block	***Device Make & Model #***	***Device Panel***
Fire1		<phone # on punch block>
Fire2		<phone # on punch block>
Security		<phone # on punch block>
Elevator		<phone # on punch block>

PART 6 - MDF/IDF ROOMS

6.1 The MDF/IDF Rooms includes those products that connect the networking equipment to the horizontal and backbone cabling subsystems. These products include termination hardware (connectors and patch cords), racks, cable management products and cable routing products.

6.2 Data / Telephone Cabling Plan

A. Provide a plan view of all building areas covered by the equipment closet meeting the following requirements:

1. Framed and secured to the wall and plan covered with clear acrylic panel.

2. Size to clearly show all required information.
3. "YOU ARE HERE" indicator with arrow.
4. Room names and numbers. Verify with Owner.
5. Show each device with symbol and identification address number as designated by owner.
6. Symbol legend.
7. True north arrow
8. Scale indicator

B. Cabling plan shall be placed on the wall adjacent to the equipment rack in each MDF/IDF room.

6.3 Rack Systems

A. MDF and IDF Racks:
1. APC AR3150 – Netshelter
2. Isolated ground power strip mounted on the lower portion of the left side of each rack to be:
   - Middle Atlantic Products Part No. PDT-2X320, or approved equal.
3. Vertical and Horizontal Cable Management
4. Ladder type cable tray shall be routed over all floor mounted racks from wall to wall.
5. Mount fiber termination cabinets in the top portion of the rack, followed by the patch panels; must adhere to Owner IT rack standards, see Section 10. Reserve the lower 50% of rack space for mounting of network electronics by the Owner.

B. IDF Racks for modular/portable buildings
1. If there are multiple modular buildings, the nearest modular building to the existing building will be designated the “Primary Fiber Uplink IDF”.
2. Each modular building, including the “Primary Fiber Uplink IDF”, shall receive an IT rack with the following:
   a. One (1) Tripp Lite SRWF4U36 Low-Profile Vertical-Mount Server-Depth Wall-Mount Rack Enclosure Cabinet
      - Wall-mount cabinet secures and organizes 4U of 19-inch rack equipment in network wiring closets and other locations with limited floor space. Houses equipment up to 36 inches deep, but extends just 8 inches from wall.
      - Includes additional 2U of space for patch panel
   b. One (1) battery backup UPS unit per rack, Eaton 5P550R
   c. One (1) UPS network card per battery back UPS unit, Eaton Network M-2
   d. One (1) 24-port patch panel per rack, CommScope CPP-UDDM-1U-24 Patch Panel
3. “Primary Fiber Uplink IDF” shall include the following, in addition to above in Section 6.2D-2:
   a. One (1) fiber wall-mount enclosure installed adjacent to the IT rack. Protective sleeve needed and routed from fiber enclosure to the IT rack; protects the fiber patch cables.
      - Commscope WB2-EMT-BK-1P-PNL or approved equal – Must be Duplex LC-type connections
   b. One (1) Cat6 cable ran from each of the other modular buildings to the “Primary-modular” IDF rack.

C. Wall-mounted Racks for smaller spaces:

1. For spaces that cannot accommodate our standard MDF/IDF racks, a wall-mounted rack is permissible with prior Owner approval.
2. Chatsworth Tinted CUBE-iT PLUS Cabinet System with 30" Depth, 48" Height
3. Include one (1) per rack, Chatsworth 12820-705 20-amp power strip, 8 outlets, NEMA 5-20P, 19” wide (1 RU).
4. Include one (1) per rack, Chatsworth 10610-019 Horizontal Rack Busbar with a Chatsworth 40162-902 2-hole lug with 3/4" bolt-hole spacing and #6 AWG green insulated copper wire to the building ground.

6.4 Cable Management

A. The Cable Management System shall be used to provide a neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures. The system shall be a complete cable management system comprised of vertical and horizontal cable managers to manage cables on both the front and rear of the rack. The system shall protect network investment by maintaining system performance, controlling cable bend radius, and providing cable strain relief.

6.5 Cable Tray

A. The Cable Tray in a Telecommunications Room / Equipment Room shall be placed to allow easy access into the room and formed as shown on drawings. Tray shall route cables from room entrance to their termination location. Tray shall use a stand-off bracket to allow cables to be routed above racks and flow easily into vertical managers.
B. All cable trays shall be grounded to ground bar located in the termination location.

6.6 Cable Termination Hardware

A. Each horizontal or backbone cabling run will be terminated using appropriate connectors or connecting blocks depending upon the cable type. Matching patch cords will be used to perform cross-connect activities or to connect into the networking/voice hardware.

6.7 MDF/IDF Rack Details

A. Rack elevation detail shall be included in the shop drawing submittal and will need approval from Owner IT team. Example in Section 10.
B. Patch panel port assignment list shall be included in the shop drawing submittal and will need coordination and approval from Owner IT team. Example in Section 10.

6.8 U/UTP Modular Patch Panel

A. The modular patch panel must be capable of housing M-Series outlets.
B. The discrete distribution module (DDM) panels should be available in a 24- or 48-port, straight configuration.
C. The panel should consist of a rack mounted base unit, rear cable management hardware, and labels for port numbering.
D. Panel should mount in a 19-inch (483mm) equipment rack with universal hole spacing.

E. The modular patch panel will be installed above and below switches. 24-port patch panels shall be installed above the top switch and below the bottom switch in each rack. 48-port patch panels shall be installed between switches in each rack.
   1. CommScope CPP-UDDM-2U-48 Patch Panel, 48 port
   2. CommScope CPP-UDDM-1U-24 Patch Panel, 24 port

F. Outlets installed in the Modular Patch Panel will be color-coded to match application, workstation drop, and patch cord as follows-

   1. CommScope Uniprise- UNJ600-BL (for all Data Drops)
   2. CommScope Uniprise- UNJ600-GN (for all WAP Drops)
   3. CommScope Uniprise- UNJ600-VL (for all Projectors)
   4. CommScope Uniprise- UNJ600-OR (for all Analog)
   5. CommScope Uniprise- UNJ600-YL (for all Security Cameras)
   6. CommScope Uniprise- UNJ600-262 White (for all intercom)

6.9 Copper Patch (Equipment) Cords

A. Category 6 patch cords to complete closet patching shall be provided by the contractor.

B. One (1) one-foot patch cords are preferred in the IT room to avoid the need for horizontal and vertical management of patch cords. Patch cords shall be from the same manufacturer as the horizontal cabling to ensure optimum performance and the color should match their respective cable run color and patch panel outlet.

C. Provide one (1) per cable drop, plus an additional five (5) for each color and type.
   1. Data- Blue category 6, UC1BBB2-0ZF001
   2. WAPs- Green category 6, UC1BBB2-0MF001
   3. Projectors- Purple category 6, UC1BBB2-0LF001
   4. Analog- Orange category 6, UC1BBB2-06F001
   5. Security Cameras- Yellow category 6, UC1BBB2-09F001
   6. Intercom- White category 6, UC1BBB2-08F001

D. Uniprise Category 6 patch cords are high-performance UTP components available in a broad range of lengths and easy-to trace colors. They are designed to meet or exceed all Category 6 specifications yet are fully backward compatible with Category 5e and lower systems.

E. 23 AWG conductors are securely mated with a patented RJ45 plug design to deliver superior electrical performance with excellent repeatability. The unique anti-snagging feature simplifies removal and replacement of patch cords.

PART 7 - BACKBONE CABLING SYSTEM

7.1 The Backbone Cable Subsystem in a building is the part of the premises distribution system that provides connection between equipment rooms, telecommunication rooms, and telecommunications service entrance facilities. A backbone subsystem provides either intra-building connections between floors in multi-story buildings or inter-building connections in campus-like environments.

7.2 All cables shall be run using a star topology (home run) from the Main Cross-Connect (MC) in the Equipment Room to each Horizontal Cross-Connect (HC) within the Telecommunications

Room. The length of each individual run of backbone fiber cable shall not exceed 2000 meters for multimode and the length of each UTP cable run for voice and data applications is not to exceed 90 meters as specified under TIA/EIA-568-C.

7.3 The type of backbone fiber cable shall be 50/125 m multimode fiber optic cable. The bending radius and maximum pulling tension of the cable shall be adhered to during handling and installation.

7.4 Fiber Backbone

A. The type of fiber cable used shall contain Laser Optimized 50-micron OM-4 Multimode fiber.

B. Termination enclosure will be located at the top of the rack housing the network equipment in the MDF Room.

7.5 Fiber Cable

A. Fiber Optic Backbone Cable shall be rated OFNP or OFNR per the installation environment as defined by the NEC and local authority having jurisdiction.

B. Multi-mode:

1. Fiber construction shall be multi-mode with a core/cladding size of 50/125 microns. Contractor shall purchase and install the appropriate CommScope fan out and breakout materials where dictated by the application and choice of fiber optic cable type. The maximum attenuation of the cable shall be 3.0 dB/km at 850nm and 1.0 dB/km at 1300nm. The cable shall be capable of supporting 10 Gigabit Ethernet to 550 meters.

C. Fiber Optic Cable size shall contain 12 fibers, and termination shall be as per the backbone diagram, or Owner requirements. All Fiber Optical Cable shall be constructed to the requirements listed in Fiber Cable Specifications.

D. All fiber links shall be tested for attenuation using a power meter and light source. The allowable attenuation for any link shall be calculated using the CommScope link loss calculator.

E. All testing shall be accomplished according to Section 11 of ANSI/TIA/EIA-568.1-D

1. CommScope 50 micron LazrSPEED 550 Multimode fiber cable P-012-DZ-5K-FSUAQ
2. CommScope Powered fiber cable, OS2, 4 Fibers, Outdoor, 12AWG conductor–PFC-S04O12F [Provide all POE extenders, connectors, power express modules, Slimline SPS DC Rectifier, and other items for complete system]

F. Fiber Optic Backbone Cable shall be rated OFNP or OFNR per the installation environment as defined by the NEC and local authority having jurisdiction.
1. Multi-Mode
   a. Fiber construction shall be multi-mode with a core/cladding size of 50/125 microns. Contractor shall purchase and install the appropriate CommScope fan out and breakout materials where dictated by the application and choice of fiber optic cable type. The maximum attenuation of the cable shall be 3.0 dB/km at 850nm

and 1.0 dB/km at 1300nm. The cable shall be capable of supporting 10 Gigabit Ethernet to 300 meters.

b. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the optical fiber cable shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual optical fiber shall not be greater than 0.15 dB/km at 1550 nm

7.6 Fiber Cable Specifications

A. This optical fiber backbone cable shall be suitable for installation in building riser systems, in conduit, in cable tray and/or in innerduct.
   1. Optical fiber cable shall be encased in an interlocking armor with an overall jacket.
      a. Optical fiber cable shall carry an OFCP (Optical Fiber Conductive Plenum) or OFCR (Optical Fiber Conductive Riser) rating, depending on installation environment.
      b. Outer Sheath: The outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, listing (OFCP or OFCR), manufacturer's identification number, and sequential length markings every two feet.
   2. Temperature Range:
      a. Storage: -40ºC to +70ºC (no irreversible change in attenuation).
      b. Operating: -20ºC to +70ºC.
   3. Humidity Range: 0% to 100%.
   4. Single Unit Cables:
      a. Maximum Tensile Strength (2 fibers).
      - During Installation: 1001 Newton (225 lb. force) (no irreversible change in attenuation).
      - Long Term: 300 N (67 lb. force).

      b. Maximum Tensile Strength (≥4 fibers):
      - During Installation: 1335 Newton (300 lb. force) (no irreversible change in attenuation).
      - Long Term: 400 N (90-lb. force).

   5. Multiple Unit Cables:
      a. Maximum Tensile Strength (≤ 24 fibers).
      - During Installation: 2670 Newton (600 lb. force) (no irreversible change in attenuation).
      - Long Term: 180 N (801 lb. force).

      b. Maximum Tensile Strength (36 to 48 fibers):
      - During Installation: 3560 Newton (800 lb. force) (no irreversible change in attenuation).
      - Long Term: 1068 N (240-lb. force).

      c. Maximum Tensile Strength (≥60 fibers):
      - During Installation: 4450 Newton (1000 lb. force) (no irreversible change in attenuation).
      - Long Term: 1335 N (300-lb. force).

   6. Bending Radius:
      a. During Installation: 20 times cable diameter.
      b. No Load: 10 times cable diameter.

7.7 Fiber Hardware

A. All Fiber Optic Termination Hardware shall be CommScope. Termination hardware in the Equipment Room shall be CommScope for Multi-mode applications. All rack mount enclosures shall be CommScope Uniprise Ready enclosures.

1. CommScope 760249997 | EPX-1U-PNL-ENC Enclosure (IDF Rooms)
2. CommScope 760251045 | EPX-2U-PNL-ENC Enclosure (MDF Room)

7.8 LC Connectors

A. When fusion splicing is not practical, Qwik-II connectors shall be used to terminate multimode fiber. All Fiber Optic Connectors shall be CommScope. They shall be available in LC style connectors.
   1. CommScope MFC-LCF-09-5X LC Connector for 0.9 mm Fiber (MM)

7.9 Fiber Optic Adapter Splice Cassettes

A. The splicing cassette is designed for use in the SD fiber shelf, which has a LGX/1000 style footprint. Fusion splices are utilized and managed inside the cassette after splicing. The cassettes are available with 12 fiber LC duplex connections in 50-micron Multi-mode fiber and Single mode Fiber versions. The splice cassette is provided with pigtails in the appropriate fiber type and fusion splice protection sleeves. Break out kits are not required when utilizing the splice cassette.
B. This product is intended for indoor use or can be used outdoors in a suitable protective enclosure.
   1. CommScope PNL-CS-12LCX-PT Splice Cassette (MM)

7.10 Fiber Pigtail Kits

A. All fiber optic pigtails and connectors shall be CommScope. Connector type shall be CommScope LC connectors for Multimode applications. Multimode pigtails shall be constructed with LazrSPEED 550 OM4 fiber.
   1. CommScope FAXLCUC0C-M003 Pigtail Kit (50-um)

7.11 Fiber Optic Patch Cords

A. All fiber optic patch cords shall be CommScope factory assembled and tested, with LC connector type. Cords shall be available in multiple jumper lengths. CommScope’s fiber optic jumpers connect the patch panel/shelf to the equipment bay.
B. Contractor will provide Four (4) Duplex 1M and Three (3) Duplex 2M patch cords per IT room
   1. CommScope FEXLCLC42-MXM001
   2. CommScope FEXLCLC42-MXM002

PART 8 – GROUNDING

8.1 ER to the building main service ground point. This ground conductor shall be utilized for equipment, termination, equipment rack, cable tray and computer equipment grounding.

8.2 All grounding and bonding shall meet the National Electrical Code (NEC) as well as local codes, which specify additional grounding and/or bonding requirements.

8.3 Bonding and Grounding

A. When required by local code, provide a Telecommunications Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding between equipment rooms and telecommunications closets. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure) and is independent of equipment or cable.

B. Bonding and grounding shall be in accordance with the NEC and NFPA. Horizontal equipment and cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.

PART 9 – EXECUTION

9.1 CABLE ROUTING AND INSTALLATION

A. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical code requirements.
B. Cable pathways, conduit, and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
C. All wiring shall test free from opens, grounds, or shorts. All communications cable shall be supported from the building structure and bundled. Do not attach any supports to joist bridging or other lightweight members.
D. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
E. Communications cable must not be fastened to electrical conduits, mechanical ductwork/piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel with line voltage electrical conductors.
F. Support shall be provided by mounting appropriate fasteners that may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles.
G. The cable pathway of supports must be positioned at least 12 inches above the ceiling grid. Communication cables shall not be run loose on ceiling grid or ceiling tiles.
H. Communication cables shall be run in conduits, where stubs are provided, from wall or floor jacks to accessible areas above finished ceilings. Conduit shall be required only within walls and concealed spaces to provide access.
I. Provide bushings to protect the cable from damage for conduit ends, box openings, and passage through metal studs.
J. Communication cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with cable Velcro hook ties randomly spaced at 30 to 48 inches on center, cable ties shall not be tight enough to deform cabling and shall not be used to support the cabling.

K. For Work Area outlets/endpoints, each cable run shall include a 20-foot service loop with Velcro hook ties located above the ceiling. This is to allow for future relocation, re-termination, or repair.
L. For MDF/IDF rooms, each cable run shall include a three-foot service loop with Velcro hook ties located in the ceiling above the rack. This is to allow for future re-termination or repair.
M. All cabling shall be placed with regard to the environment, EMI/RFI interference, and its effect on communication signal transmission.
N. Non-conductive fiber optic cable is immune from EMI/RFI interference. Give priority when selecting a route to minimize exposure to possible cable damage from maintenance or service of all systems in the attic space.
O. Do not route any data cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
P. Communication cable will not be installed in the same conduit, raceway, tray, duct, or track with line voltage electrical cable without a metallic barrier meeting NEC requirements.
Q. Maximum cable pulling tension should not exceed 25 pound-force (110 N) or the manufactures recommendation, whichever is less.
R. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
S. No terminations or splices shall be installed in or above ceilings, other than in designated end point housings.
T. Cable bends shall not be tighter that the manufacturers' suggested bend radius.
U. Mount all equipment firmly in place. Route cable in a professional, neat, and orderly installation.
V. Provide for adequate ventilation to all equipment racks and take precautions to prevent electromagnetic or electrostatic hum.

9.2 UTP CABLE TERMINATION PRACTICES

A. Insulation Displacement Contact (IDC) connectors shall be used and installed per the manufactures' recommendations.

B. Strip back only as much cable jacket as required to terminate.

C. Preserve wire-pair twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.

D. Avoid twisting cable jacket during installation.

E. Take care to ensure all data UTP wiring devices are designed for T568B wiring, T568A devices use a different pair assignment and should not be mixed.

9.3 OPTICAL FIBER CABLE INSTALLATION AND TERMINATION PRACTICES

A. The following fiber optic connector installation methods are acceptable; fusion splice connection of factory-made pigtail connectors, epoxy/polish style connectors, or non-epoxy compression cam gel style connectors. In each case, the connector manufactures' instructions shall be followed and the recommended tools and supplies, including break out kits when required, shall be used for termination and testing. All Fiber strands to be terminated including future use pairs.

B. As per industry standard - IEC 61300-3-35 during optical fiber connector termination, certify, all terminations with a 200-power microscope (minimum). Follow all of the connector manufacturers' recommendations. Unacceptable flaws in the termination's will include, but not be limited to, scratches, full or partial cracks, bubbles, pits, or residual dirt, dust, oil, moisture, grinding or sanding debris in the connector. The acceptable final inspection shall show a connector tip that is properly aligned and free of imperfections in 100% of the core and 80% of the cladding. Any connectors that fail testing shall be inspected and re-tested after rework.

C. During installation of optical fiber cable, do not allow pulling tension to exceed cable manufacturers' specification for the cable being installed. Only the strength member of the cable shall be subjected to the pulling tension.

D. Clean all optical fiber connector tips prior to inserting them into mating receptacles or bulkheads and re-install dust covers. Clean the tester launch cord prior to each insertion, as well.

9.4 WARRANTY, SERVICE, TESTING, CERTIFICATION

A. The Contractor and Manufactured shall jointly provide the Owner an extended warranty of the installed system against defects in material or workmanship for a period of no less than twenty-five years (period as is customary for the Manufacturer) from the date of substantial completion. Any equipment or cabling shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner.

B. The System Contractor shall make a thorough inspection of the complete installation to ensure the following:
   1. Complete and functional system.
   2. Installed in accordance with manufacturers' instructions.
   3. All cabling shall test free from all grounds, opens, and shorts.
   4. A representative of the Owner shall have an opportunity to be present for all final testing. Coordinate final testing with Owner, schedule as near as possible to acceptance date.

9.5 UTP CABLES AND LINK TESTING

A. Acceptance Testing: Test each conductor of every cable on the reel to verify length and continuity. Cables that have been damaged in transit must be replaced. Installed cable that proves to be defective will be replaced at the contractor's expense.

B. Final Testing: All UTP cabling will be certified to meet and or exceed the specifications as set forth for Permanent Link Testing of all Power over Ethernet electrical parameters including alien crosstalk performance. Mechanical requirement testing and test methods shall meet ANSI/CEA S–90–661 or ANSI/CEA S–102–732. Certified cable channel performance shall meet or exceed the requirements of ANSI/TIA-568, ANSI/TIA-1152-A, and ISO/IEC 11801 Standards for Structured Telecommunications Cabling Installations in a configuration up to 100 meters at swept frequencies of:
   1. 1 to 400 MHz Level III Class E for Category 6

C. Test alien crosstalk (near-end and far-end loss) for a cabling system using a network analyzer with 100-Ω pair terminations as follows;
   1. The test device consists of two jacks; one jack is connected to a main test unit and the other to a remote test unit; the main test unit and the remote test unit are connected with a field tester communication channel (patch cord or link);
   2. Six-around-one cable-bundle configuration throughout the tested length;
   3. Cable ties placed 12 inches apart for the entire length of the bundle, except the last 3.2 feet from each end; no cable-tie-induced deformation of the bundle;
   4. Modeling four-connector channel configurations using the worst-case maximum and minimum configurations to determine the worst-case for different parameters;
   5. Long channels with 90 meters of permanent link, 5 meters between the consolidation point and the telecommunications outlet, 10 meters of patch cords used to connect active equipment and cross-connect panels;
   6. Measurement of alien crosstalk (near-end and far-end loss) between all pairs of the middle disturbed cable and each pair of all adjacent cables;
   7. Measurement of power sum of all 24 adjacent pair cables.

D. The cable tester shall be ETL verified to IEC Level V accuracy or approved equal with the latest version of firmware and shall produce an electronic or printed report, noting label information, for each cable run. These reports are to be included in the close-out documentation. Testing shall be conducted with a Fluke DSX-5000 with OLTS and OTDR functions, or approved equal, permanent link adapters, high-performance channel adapters, termination plugs, 8-pin modular couplers and analysis software. Certifications shall include the following parameters for each pair of each cable installed:
   1. Characteristic Impedance 100 Ω +/- 15%
   2. Wire map (pin to pin and ground connectivity)
   3. Cable Length Permanent Link Test, station (horizontal) cable from patch panel to jack, should not exceed 295 feet (Channel length not to exceed 328 feet)
   4. DC Loop Resistance
   5. DC Resistance Unbalanced (Difference in DC Resistance between conductors of the same pair)
   6. DC Resistance Unbalanced (Difference in DC Resistance between conductors between pairs)
   7. Return Loss
   8. Insertion Loss
   9. Near End Crosstalk Loss (NEXT)
   10. Power Sum Near End Crosstalk Loss (PSNEXT)
   11. Far End Crosstalk Loss (FEXT)
   12. Attenuation Crosstalk Ratio Far End (ACRF)
   13. Power Sum Attenuation Crosstalk Ration Far End (PSACRF)
   14. Transverse Conversion Loss (TCL)
   15. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
   16. Coupling Attenuation
   17. Propagation Delay
   18. Propagation Delay Skew
   19. Power Sum Alien Near–End Crosstalk Loss (PSANEXT)
   20. Average Power Sum Alien Near End Crosstalk Loss (Average PSANEXT)
   21. Power Sum Alien Far–End Crosstalk Loss (PSAFEXT)
   22. Power Sum Alien Attenuation to Crosstalk Ratio Far–End (PSAACRF)

9.6 OPTICAL FIBER TESTING

A. Acceptance Testing: Test each strand of every optical fiber cable on the reel with an OTDR, to verify length and continuity. Fiber cables that have been damaged in transit must be replaced. Installed fiber cable that proves to be defective will be replaced at the contractor's expense.

B. Final Testing: After termination, each individual fiber of each cable segment shall be tested bi- directionally using an OTDR, both to determine the installed length and continuity. All individual fibers of each cable segment will be tested using a power meter to determine the actual loss. These readings will be taken at the 850 nm and 1300 nm windows for Multi-mode and 1310 nm and 1550 nm windows for single-mode. Testing will be in both directions. The final readings shall be listed in the certification report. These readings must not be higher than the "Optimal Attenuation Loss." The OAL will be calculated using the manufacturers' factory certified test results, (dB/Km) converted to the actual installed lengths plus the manufacturers' best published attenuation losses for the connector and/or splice installed on this project. (0.20 for Connectors and 0.10 for splices.) The OAL shall be used for comparison with the end-to-end power loss test results prior to acceptance by the construction manager.

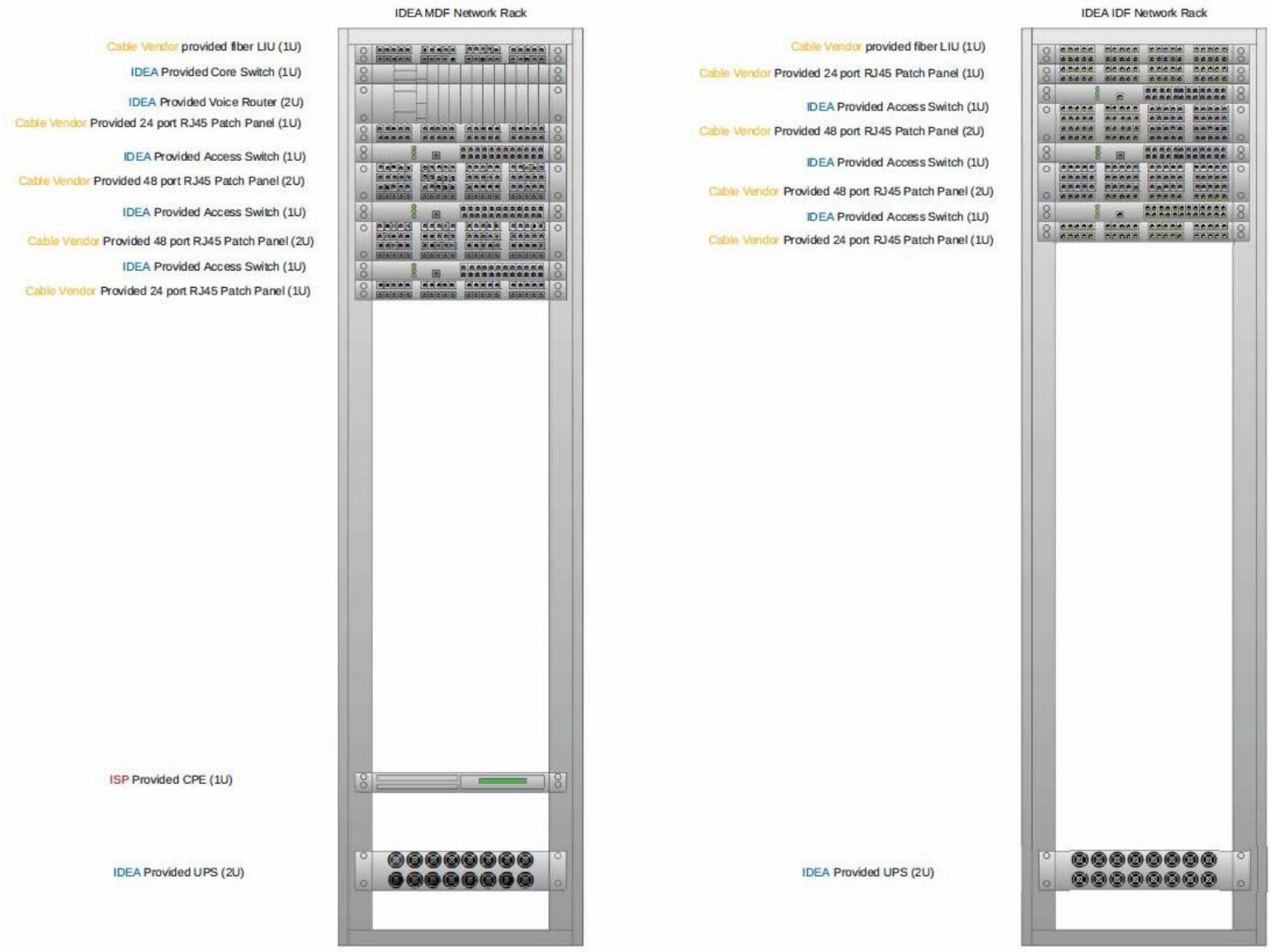
C. Fiber optic cable shall be subjected to bi-directional testing meeting ANSI/TIA-568 requirements. The cable tester shall produce a printed report, noting label information, for each cable run. These reports are to be included in the close-out documentation.

PART 10 – IT NETWORK DETAILS & REQUIREMENTS

10.1 UILDING IOT SYSTEMS SHEET (INTERNET OF THINGS

22-23 SY IDEA IoT Devices

Device Type	Device Name	Brand/Model of Device	RM/Location of Device	IP Address to be Assigned	Gateway	Subnet	Address Of New Device	Network Closet	Switch/Port #	Patch Panel Port	Installation Date	Installer Contact	Phone	Email
Security Server 1	Streamvault	Genetec		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 1	/ Corner Existing Cam	Axis?		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 2	Bldng A SW Corner	Hanwha PNM-9085RQZ		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 3	Bldng A SW Drive	Hanwha QNO-8080R		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 4	Bldng B NE Parking	Hanwha QNO-8080R		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 5	Bldng B South Drive	Hanwha QNO-8080R		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 6	Bldng B West	Hanwha QNO-8080R		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 7	Bldng C plaza	Hanwha PNM-9085RQZ		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 8	Bldng C South Parkin	Hanwha PNM-9085RQZ		10.180.X.X	10.180.X.X	255.255.255.XXX								
Security Camera 9	Bldng C West Drive	Hanwha QNO-8080R		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intrusion Panel	Bldng A Onboard IP	Bosch B5512G		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intrusion Panel	Bldng A Communicatc	Bosch B430		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intercom 1	Application Server	Valcom VE6030-1		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intercom 2	Application Server	Valcom VE6030-1		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intercom 3	IP Audio Gateway	Valcom VE1225		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intercom 4	IP Audio Gateway	Valcom VE1225		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intercom 5	IP Audio Gateway	Valcom VE1225		10.180.X.X	10.180.X.X	255.255.255.XXX								
Intercom 6	IP Intercom Controlle	Valcom VE8090		10.180.X.X	10.180.X.X	255.255.255.XXX								
HVAC 1				10.180.X.X	10.180.X.X	255.255.255.XXX								
HVAC 2				10.180.X.X	10.180.X.X	255.255.255.XXX								


IDEA MDF Network Rack
Cable Vendor provided fiber LIU (1U)
IDEA Provided Core Switch (1U)
IDEA Provided Voice Router (2U)
Cable Vendor Provided 24 port RJ45 Patch Panel (1U)
IDEA Provided Access Switch (1U)
Cable Vendor Provided 48 port RJ45 Patch Panel (2U)
IDEA Provided Access Switch (1U)
Cable Vendor Provided 48 port RJ45 Patch Panel (2U)
IDEA Provided Access Switch (1U)
Cable Vendor Provided 24 port RJ45 Patch Panel (1U)
ISP Provided CPE (1U)
IDEA Provided UPS (2U)
IDEA IDF Network Rack
Cable Vendor provided fiber LIU (1U)
Cable Vendor Provided 24 port RJ45 Patch Panel (1U)
IDEA Provided Access Switch (1U)
Cable Vendor Provided 48 port RJ45 Patch Panel (2U)
IDEA Provided Access Switch (1U)
Cable Vendor Provided 48 port RJ45 Patch Panel (2U)
IDEA Provided Access Switch (1U)
Cable Vendor Provided 24 port RJ45 Patch Panel (1U)
IDEA Provided UPS (2U)

MDF 025			
Panel/Port	Type	ROOM #	ROOM
A01	D	101	Kinder
A02	D	102	1st
A03	D	103	2nd
A04	D	104	3rd
A05	D	105	4th
A06	D	106	5th
A07	D	107	6th
A08	D	108	7th
A09	PRJ	101	Kinder
A10	PRJ	102	1st
A11	PRJ	103	2nd
A12	PRJ	104	3rd
A13	PRJ	105	4th
A14	PRJ	106	5th
A15	PRJ	107	6th
A16	PRJ	108	7th
A17	AP	101	Kinder
A18	AP	102	1st
A19	AP	103	2nd

IDF 417A			
Panel/Port	Type	ROOM #	ROOM
A01			
A02			
A03			
A04			
A05			
A06			
A07			
A08			
A09			
A10			
A11			
A12			
A13			
A14			
A15			
A16			
A17			
A18			
A19			

